FLUKE®

Instruction Manual

348007

FLUKE®

Instruction Manual

NOTE

This manual documents the Model 2204A and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix 7A for older assemblies.

Model

2204A

Scanner

P/N 495952

October 1978

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within one year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO., INC., or the nearest Service facility, giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC. will be happy to answer all application or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX 43210, MOUNTLAKE TERRACE, WASHINGTON 98043, ATTEN: Sales Dept. For European Customers: Fluke (Nederland) B.V., Zevenheuvelenweg 53, Tilburg, The Netherlands.

* For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., • P.O. Box 43210 • Mountlake Terrace, Washington 98043

Rev. 9/78

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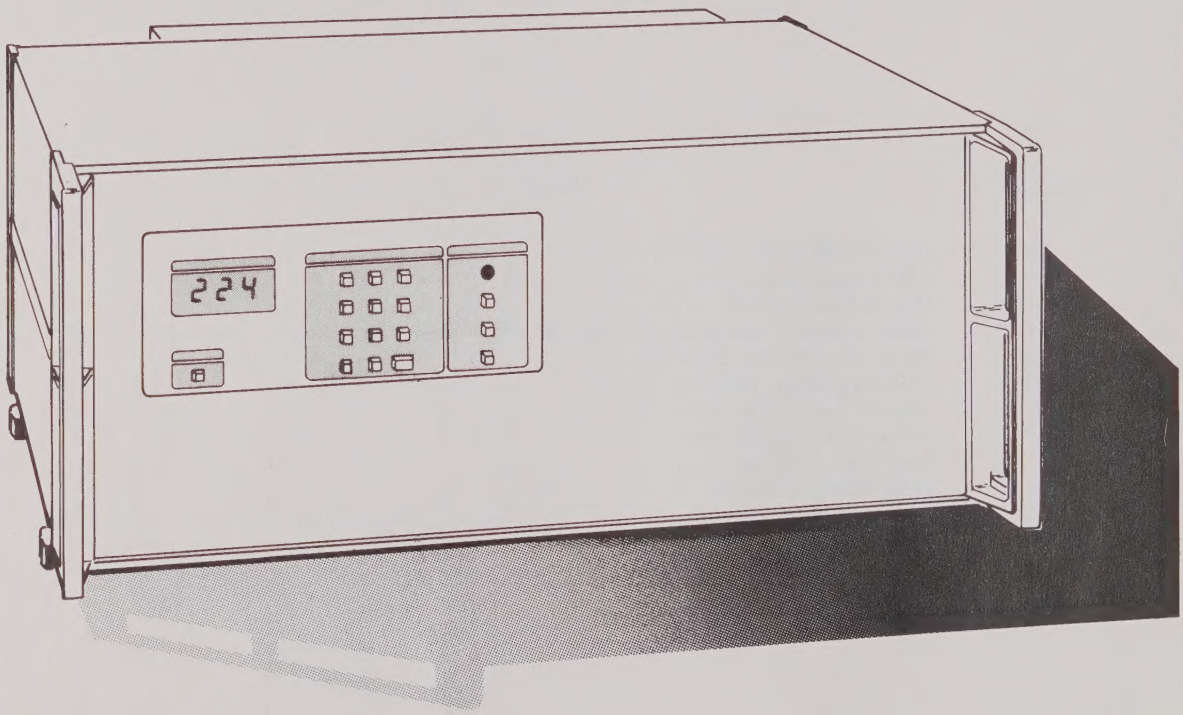


Model 2204A Scanner

Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 2204A Scanner, in its basic form, is a relay scanner mainframe capable of physically housing up to 100 data channels, and electrically controlling up to 1000. It is designed for use in a user-designed data acquisition system. Recommended system support instruments include the Fluke Model 8502A DVM for measurement purposes, any combination of up to 10 relay scanner pcb's, and a controller with either an IEEE-488 or RS-232-C I/O port. Both the scanner and the DVM must be compatible with the controller's I/O requirements. Appropriate interface options, IEEE-488 or RS-232-C, are available for the 2204A and the 8502A.

1-3. The front panel of the 2204A features all of the controls and indicators necessary for manual (local) control of the data channels. Data is entered on a calculator-type keyboard (0-9) and is displayed on a three-digit LED display. Three control switches (LOCAL, T.C. REF. JUNCTION, INCREMENT) are provided for commanding local recall (remote-to-local), thermocouple reference junction measurements, and channel increment.

1-4. The rear panel of the 2204A includes a remote control data port (IEEE-488 or RS-232-C as specified), an extender port to connect additional scanner chassis, an analog connector for connecting a DVM, and a trigger output connector for initiating a DVM reading. An analog output cable for connection between the 2204A and a Fluke Model 8502A DVM is supplied with the 2204A. The remote control cable and the trigger output cable (coax with BNC connectors) are not included with the unit. Neither is an extender cable, which is required when adding a scanner extension chassis. Extender cables are available as accessory kits and are fabricated by the user to meet his particular cable length requirements. Lengths from 3 to 1500 feet may be used depending upon the remote scanner chassis employed.

1-5. The analog input ports are also located at the rear of the 2204A. They consist of a series of 10 pcb slots (blocks) numbered from 0 through 9. Each block will accommodate a 10-channel, plug-in relay scanner card; and an input connector for supplying analog data to each of the 10 channels. Both the scanner pcb's and the input connectors are available as options.

1-6 All options and accessories available for use with the 2204A are listed in Table 1-1. Details necessary for installation, operation, maintenance, etc. are given in Section 6 of this manual.

Table 1-1. Options and Accessories

OPTION/ MODEL NO.	DESCRIPTION
2201A	Extender Scanner Chassis
2202A	Remote Scanner Chassis
2200A-7001	Remote Scanner Connector Kit
2200A-7002	Remote Scanner Cable
2200A-310	General Purpose Scanner
2200A-06	Low Level Scanner
2200A-07	Solder Pin Connector
2200A-08	Isothermal Block Connector
2204A-050	IEEE-488 Remote Interface
2204A-060	RS-232-C Remote Interface
M07-205-600	Rack Mounting Kit
M00-280-610	Rack Slide Kit
Y8001	1 Meter IEEE-488 I/F Cable
Y8002	2 Meter IEEE-488 I/F Cable
Y8003	4 Meter IEEE-488 I/F Cable
Y8004	3 Meter RS-232 I/F Cable
Y8013	Delay Trigger Cable

1-7. The 2204A may be operated from either a 50 or 60 Hz line power at any one of the following voltages: 100, 120, 220, or 240V ac ±10%. Voltage selection is accomplished on the rear panel and may be safely changed by the operator.

1-8. SPECIFICATIONS

1-9. Specifications for the Model 2204A Scanner are given in Table 1-2. Table 1-3 lists the available options and their specifications.

Table 1-2. Specifications

ELECTRICAL			
CHANNEL CAPACITY			
Main Frame	Up to 100 channels in 10 channel increments using any combination of optional scanner pcbs.		
System	Up to nine extender chassis can be serially added to the 2204A for a maximum of 1000 two-wire (hi, low, guard) channels. If four-wire channels are required, channel capacity is cut in half (500 maximum).		
CHANNEL SWITCHING RATE	Switch selectable equal to on delay plus off delay, plus logic delay.		
On Delay	2 ms or 4 ms		
Off Delay	2, 4, 6, or 8 ms		
Logic Delay	2 ms maximum		
	* Use 2 + 4 ms for General Purpose Scanners. Use 4 + 8 ms for Low Level Scanners.		
TRIGGER OUTPUT	A negative-going TTL compatible pulse of 15 μs, referenced to logic common.		
ISOLATION	Signal lines to power ground, $>10^{10}\,\Omega$.		
CROSS TALK	Less than 3 dB below applied signal from 0 to 1 MHz when terminated with with a 1 MΩ resistor.		
BANDWIDTH	With 1 MΩ termination.		
High Performance Scanner	±0.2 dB to 1 MHz		
General Purpose Scanner	±0.5 dB to 100 kHz.		
NOISE			
Common Mode Rejection (50 to 60 Hz)	−90 dB for 1 kΩ unbalance. See extender chassis specifications for CMR with added external chassis.		
Broad Band	Less than 1 μV rms for a source resistance ≤ 2 kΩ and a dc to 3 kHz bandwidth.		
Thermal	Low Level Scanner (Option -06), less than 1 μV offset. General Purpose Scanner (Option -310), less than 10 μV offset.		
LEAKAGE RESISTANCE	High-to-Low, $>10^{10}\,\Omega$.		
CHANNEL CAPACITANCE	2204A with two like scanner pcbs installed on a common bus:		
	OPEN	**CLOSED**	**EACH ADDED SCANNER PCB**
High-to-Low			
High Performance Scanner	4 pF	30 pF	2 pF
General Purpose Scanner	8 pF	70 pF	8 pF
Interchannel	3 pF	5 pF	

Table 1-2. Specifications (cont)

COMMON MODE VOLTAGE LIMIT	Guard-to-chassis; 170V dc or peak ac (50 to 60 Hz) maximum. Logic common-to-chassis; 30V dc or peak ac maximum.
ENVIRONMENTAL	
TEMPERATURE	
Operating	0 to +50°C
Storage	0 to 80% up to +40°C
GENERAL	
DISPLAY	A 3-digit LED display is used to indicate the selected channel. Also provides remote interface identification when the unit is initially turned on.
REMOTE INTERFACE	IEEE or RS-232-C Interfaces are available as options.
POWER	Selectable 100, 120, 200, or 240V ac ±10%, 50 Hz or 60 Hz, 10 VA maximum.
DIMENSIONS	See Figure 1-1. 17.8 cm H x 43.2 cm W x 44.2 cm D 7 in. H x 17 in. W x 17.4 in. D
Weight	7.1 kg (15.6 pounds).

Table 1-3. Option Specifications

OPTION -310	
GENERAL PURPOSE SCANNER	
Channel Relay	10 reed relays
Poles Per Channel	Two (form A)
Shield Switching	One switch for 10 channels
Voltage Offset	$\leqslant 10\,\mu V$
Switch Life Time	$\geqslant 10^7$ operations
Contact Current	40 mA maximum
Input Voltage Limit*	170V dc or peak ac maximum
Common Mode Voltage Limit (Voltage between chassis and any input)	170V dc or peak ac maximum provided the Input Voltage Limit is not exceeded.
Over-Current Protection	40.2Ω resistor in series with each input line.

* Maximum voltage between any two terminals in the system. Includes normal mode as well as common mode voltages.

OPTION -06	
LOW LEVEL SCANNER	
Channel Relays	10 low thermal-emf reed relays.
Poles Per Channel	Three (includes shield switch).
Shield Switching	One switch per channel.

Table 1-3. Option Specifications (cont)

Voltage Offset	≤1 μV.
Switch Lifetime	$\geq 10^7$ operations.
Contact Current	15 mA maximum.
Input Voltage Limit*	170V dc or peak ac maximum
Common Mode Voltage Limits (Voltage between chassis and any input)	170V dc or peak ac provided the Input Voltage Limit is not exceeded.
Over-Current Protection	470Ω resistor in series with each input line.

* Maximum voltage between any two terminals in the system. Includes normal mode as well as common mode voltages.

OPTION -07
SOLDER PIN CONNECTOR

Compatibility	Mates with either the -310 or -06 scanners.
Terminal Style	Solder Type.
Number of Terminals	30 (High, Low, Shield per channel). 14 (not used).

OPTION -08
ISOTHERMAL BLOCK CONNECTOR

Compatibility	Mates with either the -310 or -06 Scanners.
Terminal Style	Screw Type.
Number of Terminals	30 (High, Low, Shield per channel).
Temperature Gradient between any terminals	±0.05° C maximum.
Reference Junction Stability	±0.005° C per ° (0° C to 50° C).

OPTION -050
IEEE-488 INTERFACE PCB ASSEMBLY — When equipped with the IEEE-488 Interface the 2204A functions as a basic listener (L2) with Device Clear (DC1) and complete remoite/local capability (RL1).

OPTION -060
RS-232-C INTERFACE PCB ASSEMBLY

Timing Format	Asynchronous
Output Format	Bit-Serial
Output Code	Seven-level ASCII
Baud Rates	110, 134.5, 150, 300, 600, 1200, 2400, 4800 (switch selectable).
Operating Power:	Derived from 2204A.
Parity	Not used.
Stop Bits	Two.
Signal Levels	EIA voltage level inputs.

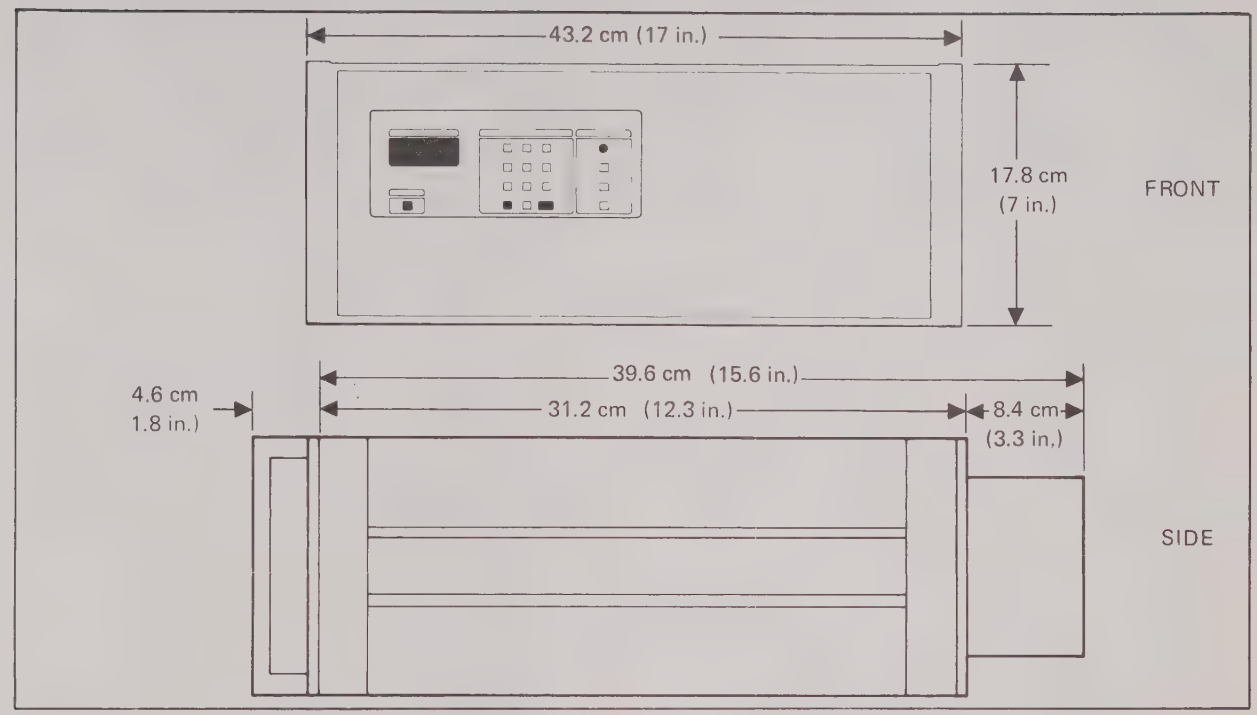
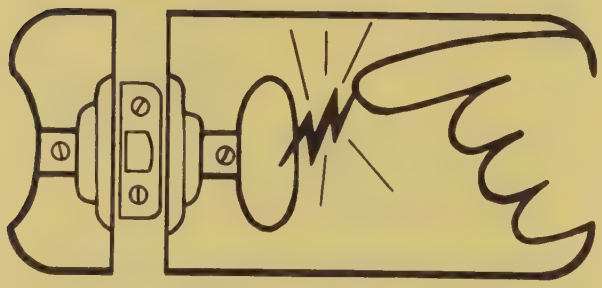


Figure 1-1. Outline Drawing

static awareness

A Message From

John Fluke Mfg. Co., Inc.

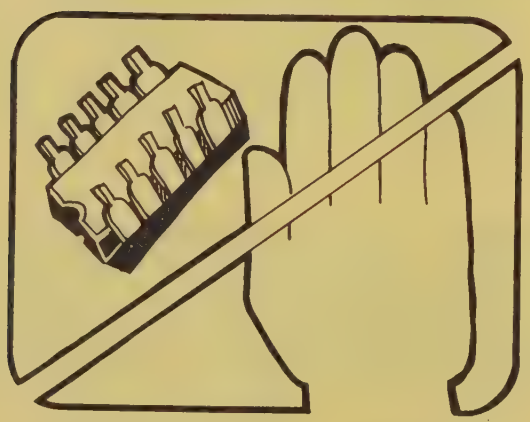


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

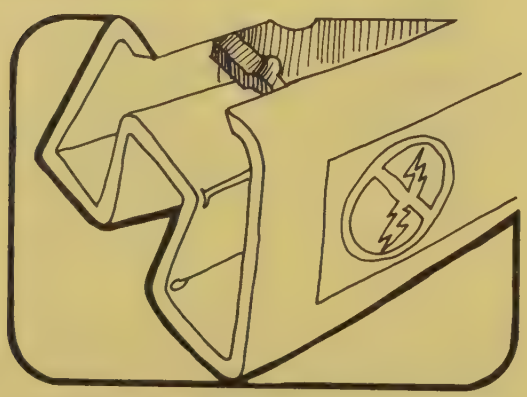
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗".

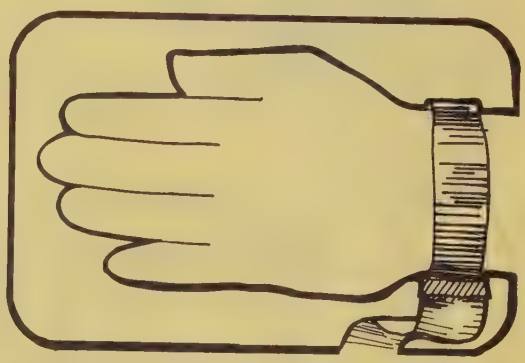
The following practices should be followed to minimize damage to S.S. devices.



1. MINIMIZE HANDLING

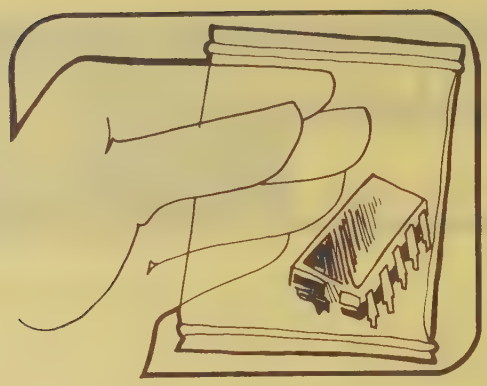


2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.

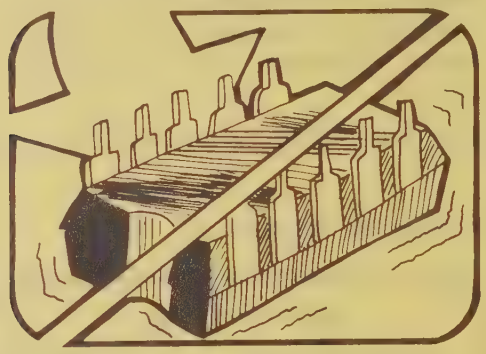


3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES

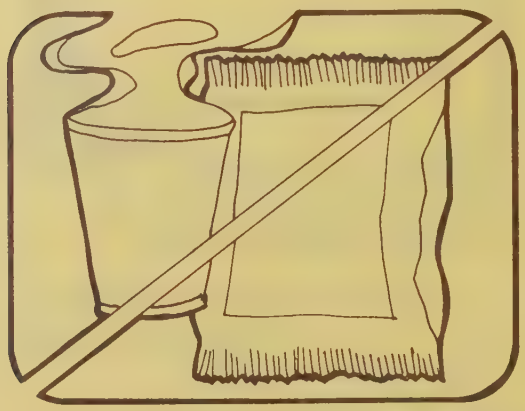
4. HANDLE S.S. DEVICES BY THE BODY



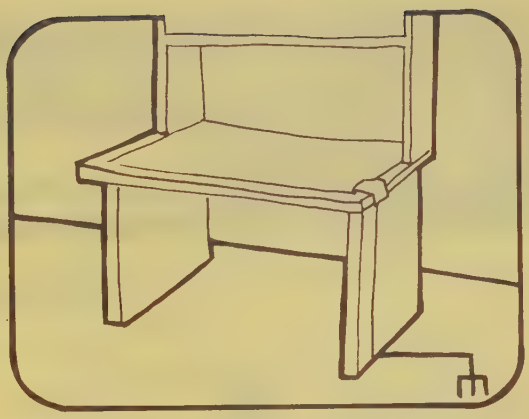
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYRAFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains information concerning the installation and operation of the Model 2204A Scanner. It is recommended that the contents of this section be read and understood before any attempt is made to operate the instrument. Should any difficulties arise during operation, contact your nearest John Fluke Sales Representative, or the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA, 98043, Telephone (206) 774-2211. A list of sales representatives is given in Section 7.

2-3. SHIPPING INFORMATION

2-4. The 2204A is packaged and shipped in a foam-packed container. Upon receipt of the instrument, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included on the shipping carton.

2-5. If reshipment of the instrument is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the instrument's model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. The 2204A can be configured to operate from any one of the following voltages: 100, 120, 220, or 240V ac ±10%, 50 to 60 Hz. A rear panel decal indentifies the line voltage selected prior to shipment. If one of the other voltage configurations is required, complete the procedure given in Figure 2-1.

2-8. FUSE REPLACEMENT

2-9. The line fuse is safely accessible from the rear of the 2204A and can be easily replaced by the operator. Use the following procedure to check and/or replace the fuse.

1. Set the power switch to OFF and disconnect the power cord from the 2204A. The fuse compartment is located just below the power connector.

2. Open the fuse compartment by sliding the see-thru fuse cover toward the power connector.

3. Locate FUSE tab (next to fuse) and gently lift it up. This releases and lifts one end of the fuse.

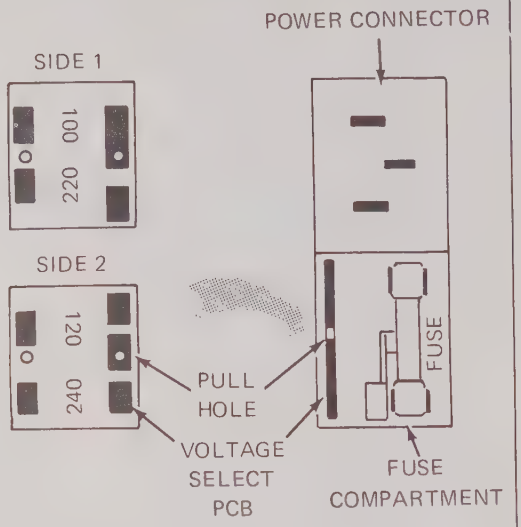
4. Remove and inspect fuse. If replacement is required, use MDL 1/8 amp fuse for 100/120V ac operations and MDL 1/16 amp fuse for 220/240V ac operation.

5. Lower FUSE tab and press good fuse into the fuse holder.

6. Close fuse compartment and connect power cord.

2-10. RACK INSTALLATION

2-11. The 2204A is designed for either bench-top use or for installation in a standard 19-inch equipment rack. If rack mounting is desired, two rack mounting kits are available, a standard Rack Mount Kit (Model no. M07-205-600) and a Rack Slide Kit (Model no. M00-208-610). Installation instructions for both models are given in Section 6, Option and Accessory Information.



LINE VOLTAGE SELECTION

1. Set POWER switch to OFF and disconnect power cord from 2204A.
2. Open fuse compartment by sliding see-thru fuse cover toward power connector.
3. Locate voltage select PCB in fuse compartment.
4. Pull pcb from its slot by inserting a scribe or long-nose pliers into the Pull Hole.
5. Position pcb between thumb and forefinger until the desired voltage (100, 120, 220, 240) appears upright on the thumb side.

6. Position free end of pcb above slot so that selected voltage faces the fuse. Press pcb into slot.
7. Check and, if necessary, change the fuse to accomodate the selected line voltage.

   100/120V ac – 1/8 amp MDL
   220/240V ac – 1/16 amp MDL

8. Close fuse compartment and connect power cord.

Figure 2-1. Line Voltage Selection Details

2-12. OPERATING FEATURES

2-13. All controls, indicators, and connectors for the 2204A are shown in Figure 2-2 and described in Table 2-1.

2-14. OPERATING NOTES

2-15. The following paragraphs describe various conditions which should be considered before operating the 2204A.

2-16. AC Line Connections

2-17. The rear-panel, three-prong, line-power connector permits the 2204A to be connected, through the power cord, to the local line voltage (100, 120, 220 or 240V ac; 50 or 60 Hz). The offset prong on this connector is connected to the 2204A chassis and should be connected, via the power cord, to a high quality earth ground.

2-18. Scanner PCB's

2-19. The 2204A is designed to accomodate, in any combination, up to 10 of the available scanner pcb assemblies. Scanners are options and are described in Section 6 of this manual. Descriptions include all information necessary to install, operate, and maintain the units.

2-20. Each scanner is designed as a 10-channel block using a common output bus. That is, when any one of the 10 channels is selected, that channel (high, low, guard) is connected to a 2204A scanner bus for measurement (sometimes stimulus) purposes. Remember, different applications may require different scanner pcb's. Review the scanner specifications in Section 6 to ensure compatibility between the scanner pcb and the intended application.

2-21. Scanner I/O Connectors

2-22. External connection to the scanner pcb's (10-channel blocks) is accomplished using a series of rear-panel connector assemblies (one for each scanner pcb) which are available as options. The connectors are available in a variety of configurations (see Section 6) and should be selected to match the individual scanner pcb applications.

2-23. Scanner Extension

2-24. The channel scanning capacity of the 2204A can be extended from 100 channels up to 1000 channels. The

extension is accomplished through the use of one or more of the Model 2201A/2202A/2203A Scanner Chassis which are available as accessories. The units interconnect in a daisy-chain fashion, and the first unit in the chain connects to the EXTENDER CABLE I/O connector on the rear of the 2204A. See Figure 2-3.

2-25. Each scanner chassis is capable of housing and controlling either 10 (2202A or 2203A) or 12 (2201A) scanner blocks. Since each block contains 10 channels, a total of 100 or 120 channels can be added with each scanner chassis included in the daisy-chain. The 2201A, 2202A and 2203A Scanner Chassis are documented in separate stand-alone manuals.

2-26. Scanner Busses

2-27. The 2204A is equipped with two analog busses, bus 1 and bus 2. Bus 1 is associated with even block numbers (0, 2, 4, 6, 8) and bus 2 is associated with odd block number (1, 3, 5, 7, 9). Each bus consists of three lines; high, low and guard. When any channel relay is closed on a given block, that channel and its data is connected to the appropriate bus.

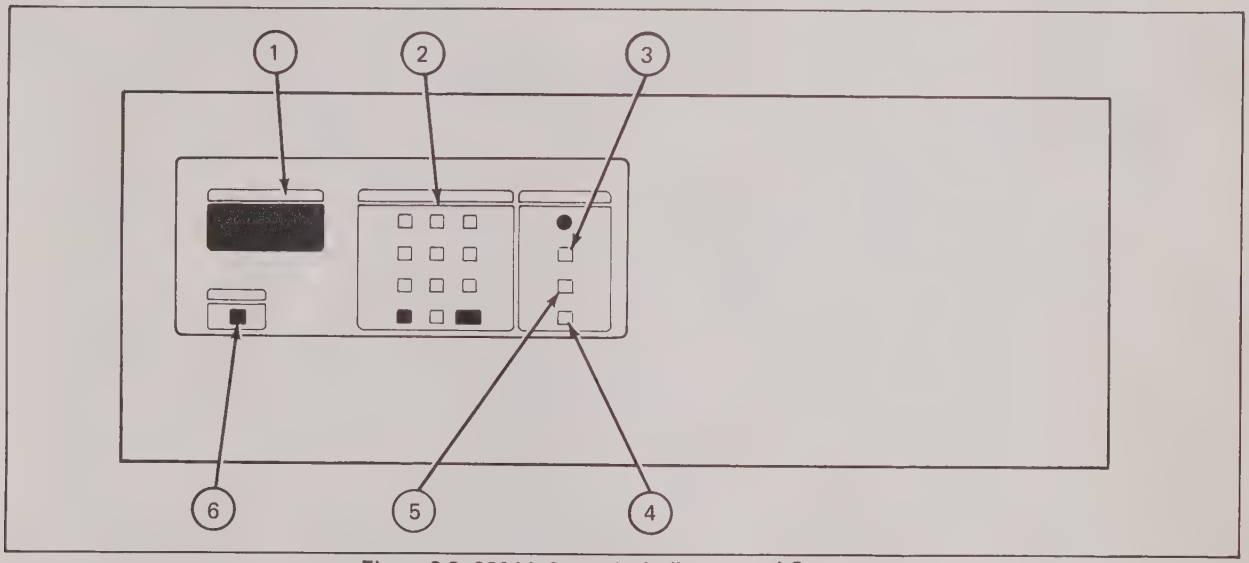


Figure 2-2; 2204A Controls, Indicators and Connectors

Table 2-1. 2204A Controls, Indicators and Connectors

REF NO.	NAME	FUNCTION
1	CHANNEL DISPLAY	Three seven-segment LEDs used to indicate the displayed or selected channel (000 through 999). Also indicates baud rate/ address for remote interface and data entry messages.
2	DATA Keyboard	Calculator type keyboard, with CLEAR and ENTER switches, used for manual entry of channel control data.
3	LOCAL Switch, REMOTE LED	A pushbutton switch used to recall local (manual) operating mode if unit is in remote. REMOTE LED is lit in the remote mode.
4	INCREMENT Switch	A pushbutton switch used to manually increment the displayed channel.
5	T.C. REF JUNCTION Switch	A pushbutton switch used to manually select (for measurement) the reference voltage of a displayed channel, 0 through 999. An r is displayed to indicate that a reference voltage is selected.
6	POWER Switch	A green push-push switch used to turn the instrument on and off.

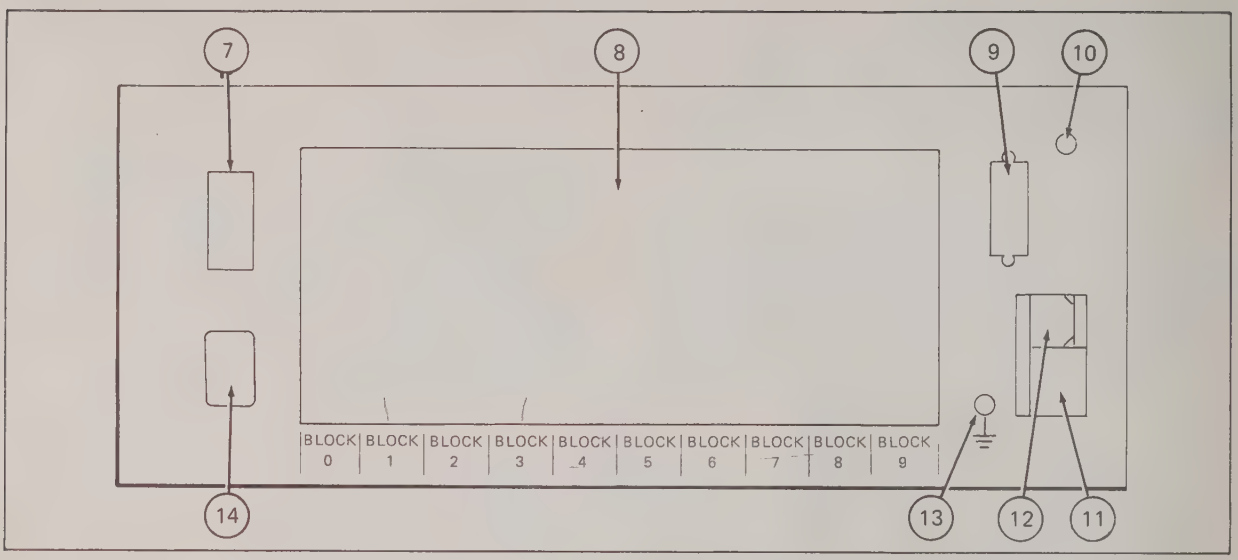


Figure 2-2. 2204A Controls, Indicators and Connectors (cont)

Table 2-1. 2204A Controls, Indicators and Connectors (cont)

7	EXTENDER CABLE I/O	This 36-pin connector is used as a data I/O port for controlling the operation of additional scanner chassis. Up to nine such chassis can be added in a serial fashion for a total of 1000 channels.
8	ANALOG INPUTS	Access to the analog scanners (Block 0 through 9) is provided when the snap-on rear cover is removed. One input connector (optional) is required for each scanner pcb (block of 10 channels installed).
9	REMOTE CONTROL DIGITAL I/O Connector	A 25-pin connector used as a control port for receiving remote control data. The data format is RS-232-C (-060) or IEEE-488 (-050) compatible depending upon the installed option.
10	TRIGGER OUTPUT Controller	This BNC Connector provides electrical access to the Trigger Output pulse; a 15 μsec pulse used to trigger a measurement. The pulse is negative-going, TTL compatible, and is generated after each channel selection is complete. The pulse is referenced to logic common, not chassis ground.
11	Fuse Holder	The line power fuse and the voltage-select pcb are housed in this compartment. The line cord must be removed before the compartment can be opened.
12	POWER INPUT Connector	A 3-prong connector used to connect the instrument (via the line cord) to line power.
13	Ground Connector	This binding post provides a convenient connection to chassis ground.
14	ANALOG CABLE OUTPUT Connector	Both analog busses are electrically accessible for measurement purposes via this connector. An analog cable supplied with the 2204A completes the connection between the busses and the 8502A (DVM) analog input.

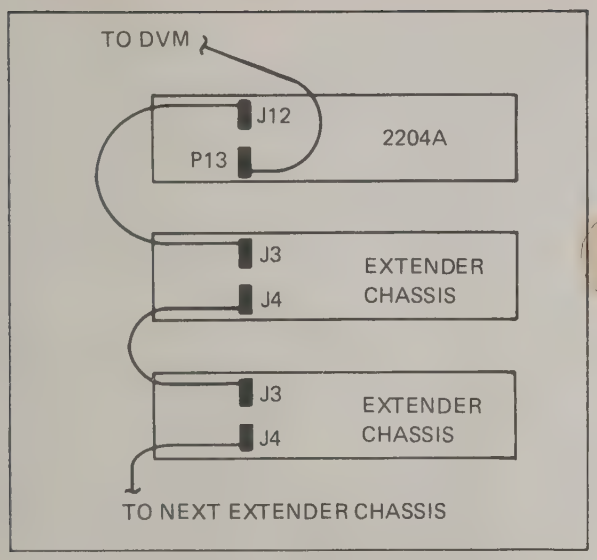


Figure 2-3. Extender Cable Connections

2-28. Channel relays may be closed singly or in pairs. If closed singly, the analog busses should be connected in parallel at the analog output cable so that a single bus is formed. This configuration is generally termed two-wire operation. That is, a single two-wire bus (high, low, guard) is common to all channels. If the relays are closed in pairs, the busses should remain electrically isolated so that two separate busses (bus 1 and bus 2) are available at the analog output connector. This configuration, is termed four-wire operation. that is, a single four-wire bus (high 1, high 2, low 1, low 2, guard, shield 2) is common to all channel pairs. Guard and shield 2 are generally connected together at the analog output cable to form a single instrument guard. The desired bus configuration is manually selected, and applies to all channels in the 2204A.

NOTE

Bus configuration is not an operator function. Refer to Section 4 of this manual for the two-wire and four-wire bus selection procedures.

2-29. In the four-wire configuration, a relay pair is selected by commanding a channel on one of the even numbered blocks (0, 2, 4, 6, 8). The commanded channel plus the same channel on the adjacent odd numbered block is closed. Thus, blocks 0 and 1, 2 and 3, 4 and 5, 6 and 7, 8 and 9 operate as pairs. Commanding a channel on an odd numbered block will close only that channel, not the pair.

NOTE

Four-wire operation is possible only in the 2204A. Extender chassis are configured for two-wire operation.

2-30. Analog Cable

2-31. An analog cable is provided with the 2204A. It is designed to connect the analog busses to the 8502A input and sense terminals. Jumpers are installed on the connector to unite the busses for two-wire operation. If four-wire operation is preferred, the jumpers should be removed from the scanner-end of the cable. See Figure 2-4. These jumpers parallel the two analog busses and make them appear as a single bus; high, low, guard.

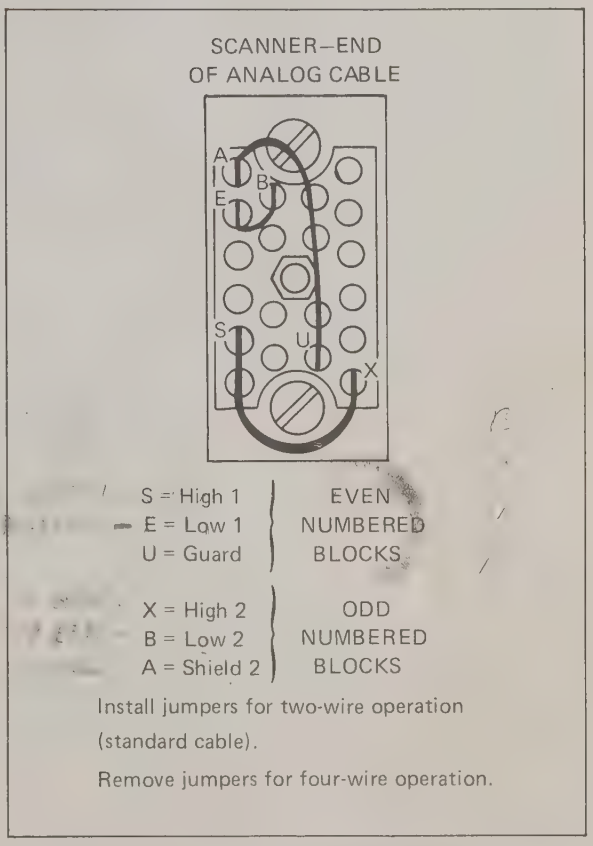


Figure 2-4. Analog Connector Jumpers

2-32. Trigger Output

2-33. A trigger pulse is available on the rear panel of the 2204A at the BNC connector marked TRIGGER OUTPUT. Its function is to serve as a measurement command to a Model 8502A (systems type DVM). The pulse is generated after a channel is selected and settled (settling time is determined by the trigger delay switch settings described in the next paragraph). The trigger pulse is TTL compatible and occurs as a 15 μsec negative-going pulse (+5V dc to Logic Common). System-type closed-loop operation cannot be achieved by using the trigger pulse.

CAUTION

The low side of the TRIGGER OUTPUT connector is connected to Logic Common, not chassis ground. Do not connect the low side of the connector to a potential more than 30V above chassis.

2-34. Trigger Delay Switch

2-35. The elapsed time between channel selection and the Trigger Output pulse can be selected to ensure that the channel relays operate in a break-before-make pattern. Eight patterns are available and, of these, two are recommended for use with particular scanner types. These delays are set when the scanning pcb's are installed, and are not intended as an operator controlled function. Figure 2-5 defines each of the possible delay patterns. The times listed are fixed and cumulative. When a channel select command is received the affected relays operate in a break-before-make pattern and settle within the alloted time period. Instructions for setting the trigger delay switches are given in Section 4.

DELAY PATTERN	DELAY TIMES IN MS *		
	OFF	ON	LOGIC (MAX)
0	2	2	2
1*	4	2	2
2	6	2	2
3	8	2	2
4	2	4	2
5	4	4	2
6	6	4	2
7*	8	4	2

A = Channel selection is initiated. Currently closed channel is released.

OFF = Time allowed for released channel to open and settle.

B = Newly selected channel is commanded to close.

ON = Time allowed for new channel to close and settle (maximum). Trigger pulse is sent at the end of this time.

LOGIC = Cumulative selection is complete. Trigger Out pulse is initiated.

* Pattern 1 is recommended for use with General Purpose Scanner PCB's.

Pattern 7 is recommended for use with Low Level Sanner PCB's or a combination of both scanner types.

Figure 2-5. Trigger Delay Patterns

2-36. Local Control

2-37. The scanning functions of the 2204A can be manually controlled using the front panel switches. This method of control is generally reserved for verifying scanner operation. However, it may prove useful for other applications. Table 2-2 lists the functions that may be performed and their respective control sequences. When a sequence is properly entered the selected channel data will appear in the CHANNEL DISPLAY. Other indications that may appear are defined in Table 2-3.

NOTE

The following list of control operations are not normally encountered. However, if employed, their effect on the 2204A operation should be noted.

1. When selecting an upper boundary, any digit other than 0 (zero) can be used in place of the recommended 1.

2. When setting high/low boundaries the increment command may be inserted between the last digit and the first enter command.

3. Multiple enter commands should be used with care. An even number of enter commands followed by a digit will set a boundary. An odd number of enter commands followed by a digit will cause the digit to be displayed.

4. With the exception of the Auto Scan Mode, simultaneous keyboard entries are undefined.

5. Rapid successive power-on/power-off switching may cause the 2204A to lockup. A slow power-off/power-on sequence will clear the lockup condition.

6. If a remote interface is not installed in the 2204A, and the auto scan rate is set to 3.3 seconds (slowest rate), the unit will display Err (error) on power up. Ignore the error message.

2-38. Auto Scan Mode

2-39. The auto scan mode is a free-run scanning condition that can be manually initiated using the front panel controls (auto scan cannot be remotely commanded). Upper and lower channel boundaries can be assigned so that the scanning cycle includes only the channels of interest. For example, if 3 and 5 are assigned as lower and upper boundaries respectively, the auto scan mode, when initiated, will continuously cycle from channel 3 through channel 5. The timing for the relay switching and the Delay Trigger is the same as that of the normal scan sequence. In fact, the only difference between the two modes is that the auto scan mode

Table 2-2. Front Panel Control Functions

FUNCTION	FRONT PANEL CONTROL SEQUENCE
Select a channel	DIGIT DIGIT DIGIT ENTER
Clear the display	CLEAR
Open all channels	CLEAR ENTER
Reset boundaries to 0 and 99	CLEAR ENTER ENTER
Set and select lower boundary channel	DIGIT DIGIT DIGIT ENTER ENTER 0
Set and select upper boundary channel	DIGIT DIGIT DIGIT ENTER ENTER 1
Select next higher channel	INCREMENT
Initiate the auto scan mode	INCREMENT and LOCAL Simultaneously
Exit the auto scan mode (last channel is still selected)	CLEAR
Exit the auto scan mode and clear all channels	CLEAR ENTER
Select isolthermal block of displayed channel	T.C. REF. JUNCTION
Go to local. Remote light will go out.	LOCAL
Clear error condition	CLEAR

increments automatically at a selectable time rate, and the normal mode increments only when manually or remotely commanded. The available auto scan rates range from 0.2 to 3.3 seconds per channel. They are switch selectable in 0.1 second increments. Refer to Section 4 of this manual for the auto scan rate selection procedure.

2-40. Remote Programming

2-41. In a systems configuration, the 2204A can be remotely programmed/controlled via the rear panel REMOTE CONTROL port. Data format, RS-232-C or IEEE-488, is determined by which one-of-two interface pcbs is installed in the 2204A, the RS-232-C Interface PCB (Option -060) or the IEEE-488 Interface PCB (Option -050). To positively identify the pcb installed in a given unit, observe the CHANNEL DISPLAY when the 2204A is initially energized. If an IEEE option is installed, the display will read A followed by a numeric listen address code (A0 through A30). If an RS-232-C option is installed, a b followed by a numeric baud rate code (b0 through b7) will be displayed. If the interface pcb must be changed, refer to Section 6 for the installation and interface details.

Table 2-3. Channel Display Indications

DISPLAY READING	DEFINITION
–––	All channels open
–	Clear entry
Err	Function or control sequence is in error, try again.
Axx	Address for IEEE Interface. (xx = 0 thru 30)
b-x	Baud rate for RS-232-C Interface (x = 0 thru 7)
xr	Temperature reference selected. (x = channel 0-99)

2-42. IEEE-488 INTERFACE (OPTION -050)

2-43. The IEEE-488 Interface is designed to meet the intent and requirements of the IEEE-488 Standard. Once installed it requires no operator attention other than

identification of the IEEE listen address code as previously described. Scanner control functions and their corresponding ASCII control characters are given in Table 2-4. After the interface is addressed, the 2204A will respond to subsequent control data. Refer to Section 6 for a detailed description of IEEE-488 Interface.

2-44. RS-232-C INTERFACE (OPTION -060)

2-45. The RS-232-C Interface is designed to meet the intent and requirements of the Electronic Industries Association Standard RS-232-C. Once installed, it requires no operator attention other than verification of the baud rate. This appears on the display when the 2204A is initially energized. Display indications for the various baud rates follow:

1.	b-0	=	110 baud
2.	b-1	=	134.5 baud
3.	b-2	=	150 baud
4.	b-3	=	300 baud
5.	b-4	=	600 baud
6.	b-5	=	1200 baud
7.	b-6	=	2400 baud
8.	b-7	=	4800 baud

NOTE

During normal TTY operation, all baud rates are useable. If a controller is used at baud rates of 1200, 2400 and 4800; commands may be missed if consecutive channel selections are made at a rate that is faster than the relays can switch. See Figure 2-5, for relay switching times.

2-46. Scanner control functions and their corresponding ASCII control characters are given in Table 2-4. Refer to Section 6 for a detailed description of the RS-232-C Interface.

2-47. OPERATION

2-48. With reference to the previous paragraphs use the following procedure to operate the 2204A.

NOTE

This procedure assumes that the scanner has been equipped with the desired scanner pcb's, input connectors, and/or other desired options/accessories. It also assumes that the unit has been incorporated into its normal operating environment and is connected to line power.

1. Energize the 2204A by pressing the POWER switch.

2. Observe the DISPLAY and verify the displayed baud rate (RS-232-C) or listen address (IEEE-488).

3. Enter control data using either local or remote commands. If local control is desired after a remote control sequence, press the LOCAL switch before attempting to enter data. See Table 2-2 for a complete list of manual control functions. See Table 2-4 for equivalent remote control functions.

Table 2-4. Remote Control Characters

KEYBOARD CONTROL SEQUENCE	EQUIVALENT REMOTE CONTROL CHARACTER SEQUENCE (ASCII)	REMARKS
0 thru 9	0 thru 9	Numeric data
ENTER	,	Select displayed channel
INCREMENT	+	Increment displayed channel by one
CLEAR	$	Clear display
T.C. REF JUNCTION	R	Select reference junction of the displayed channel
CLEAR ENTER	* or $,	Open all channels
NONE	B0	Set lower boundary
NONE	B1	Set upper boundary
CLEAR ENTER ENTER	*, or $,,	Reset boundaries to 0 and 99
ENTER ENTER 0	,,0	Select channel and set lower boundary
ENTER ENTER 1	,,1	Select channel and set upper boundary
NONE	L	Set local lockout (RS-232-C only)
NONE	L0	Reset local lockout (RS-232-C only)

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description followed by a block diagram analysis of the Model 2204A Scanner. Simplified diagrams are used to support the block diagram analysis. Detailed schematics of individiual pcb assembly are given in Section 8.

3-3. OVERALL FUNCTION DESCRIPTION

3-4. The 2204A, as shown in Figure 3-1, is a scanner mainframe complete with power supply, room for up to 10 scanner blocks (10 channels per block), the logic necessary for local operation, and the front panel controls and indicators necessary for a man/machine interface. It is designed to provide controlled random or sequential access to up to 100 channels of external analog data (via the channel inputs) for measurement purposes.

3-5. Functionally, the 2204A is a controllable 100 channel scanner (when ten optional scanner pcb's are installed) that is electrically capable of being expanded up to 1000 channels, using a series of (up to nine) Scanner Extender Chassis (Models 2201A, 2202A and/or 2203A). Internal microprocessor based logic allows a scan sequence to be either manually or remotely defined, displayed, and incremented on manual, automatic, or remote command. Analog data to a selected channel is presented to a common scanner bus which is electrically accessible via a rear panel connector. Normally, the bus is connected to a DVM input (Model 8502A is recommended). After a channel is selected, the 2204A generates a Trigger Output pulse. This externally accessible pulse is used to command the DVM to read the analog bus, and thus, the analog input to the selected channel.

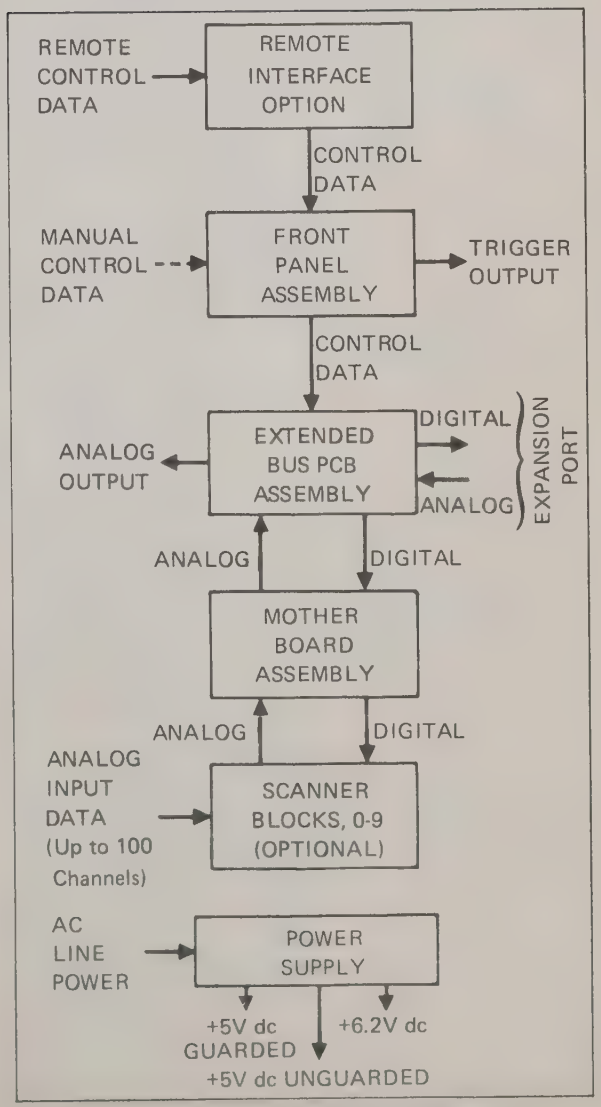


Figure 3-1. 2204A Simplified Block Diagram

3-6. BLOCK DIAGRAM ANALYSIS

3-7. Front Panel PCB Assembly

3-8. The Front Panel PCB Assembly, as shown in Figure 3-2, functions as the data processor for the 2204A. It consists of an 8-bit microcomputer (U6), a system oscillator, an onboard keyboard, a 3-digit display, an output trigger driver, and a set of switches to define the output trigger delay time and remote interface requirements. Program data can be entered manually using the keyboard or remotely by way of the data bus and an interface option (RS-232-C or IEEE). Updated channel select information is presented to the display via an 8-bit register and serially output to the Extended Bus PCB Assembly as control data.

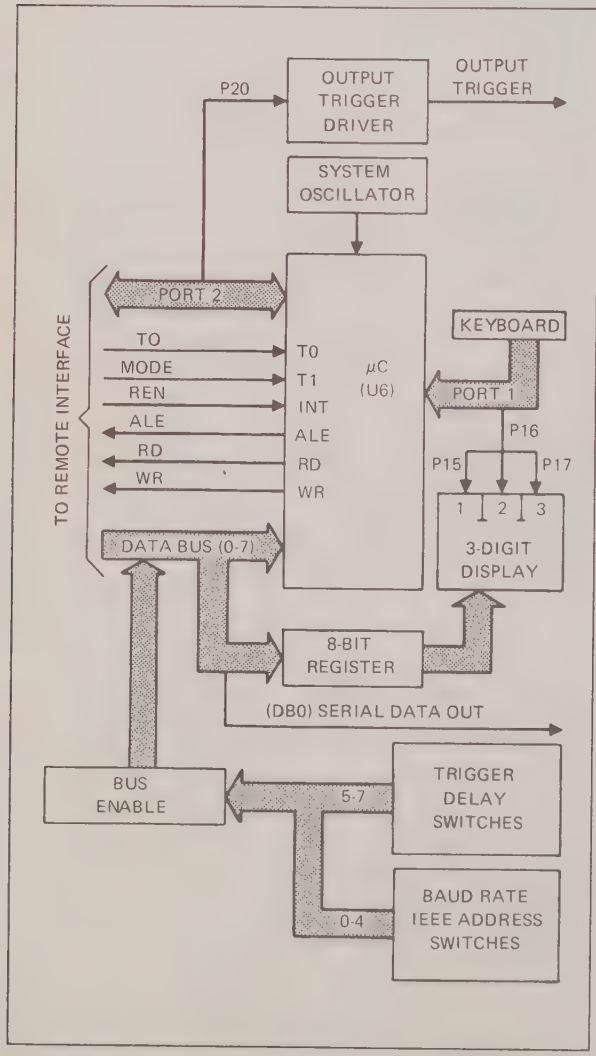


Figure 3-2. Front Panel Display PCB Assembly

3-9. The microcomputer (μC) used in the 2204A is a single component device complete with an 8-bit CPU, EPROM, RAM, and two I/O ports. All scanner activity is under control of the μC. This includes local and remote data entry, data display, trigger delay, scan control and remote interface programming (baud rate, IEEE address, or auto scan rate).

3-10. System control data leaving the Front Panel PCB Assembly is limited to bit-serial channel selection data (14 characters) and an output trigger. Channel selection data is stored as a 12-bit parallel word on the Extended Bus PCB Assembly where it is used to energize the selected channel (000-999). A predetermined (switch selected) delay is initiated when a channel selection is made. At the end of the delay (i.e.,after the make-before-break switching is complete), an output trigger is generated to enable the DVM to make an analog measurement of the analog signal at the selected channel.

3-11. Extended Bus PCB Assembly

3-12. The Extended Bus PCB Assembly, as shown in Figure 3-3, is designed to store, decode, and distribute the digital channel select data received from the Front Panel PCB Assembly. The extended bus consists of a pair of dual shift registers (U6 and U7), three 4-bit latches (U2, U3 and U12), a 1-of-10 decoder (U10), a 4-bit multiplexer (U9), and a pair of analog switching relays (K1 and K2). Incoming serial data is entered into the serial data register as a 12-bit data word preceded by two fixed start bits (10). When the first bit (1) is shifted into the fourteenth position a transfer command is generated to load the 12 parallel data outputs of the serial registers into the parallel data register. The parallel data output is used to provide channel select commands to both the local scanner pcb's and the remote scanner chassis. This dual register technique is known as double buffering. It is used to prevent the scanners from responding while new data is being entered into the serial register.

3-13. The 12-bits of channel select data are divided into three bcd command groups; units, tens, and hundreds. These lines are buffered and output to a rear panel selector for use in commanding up to 999 external channels. Internally, the channel select lines are used to control channels 0 through 99. Lines 0 through 4 are buffered and used as bcd channel select commands 0 through 9. Lines 5 through 9 are decoded into 10 discrete controls for selecting one of the 10 possible internal scanner blocks. When four-wire operation is required one even block (0, 2, 4, 6, 8) and the next higher odd block are enabled simultaneously. This is accomplished by a four-bit multiplexer which supplies either even or odd commands to the odd numbered scanner blocks. An internal switch setting (two-wire/four-wire) controls the multiplexer's operation.

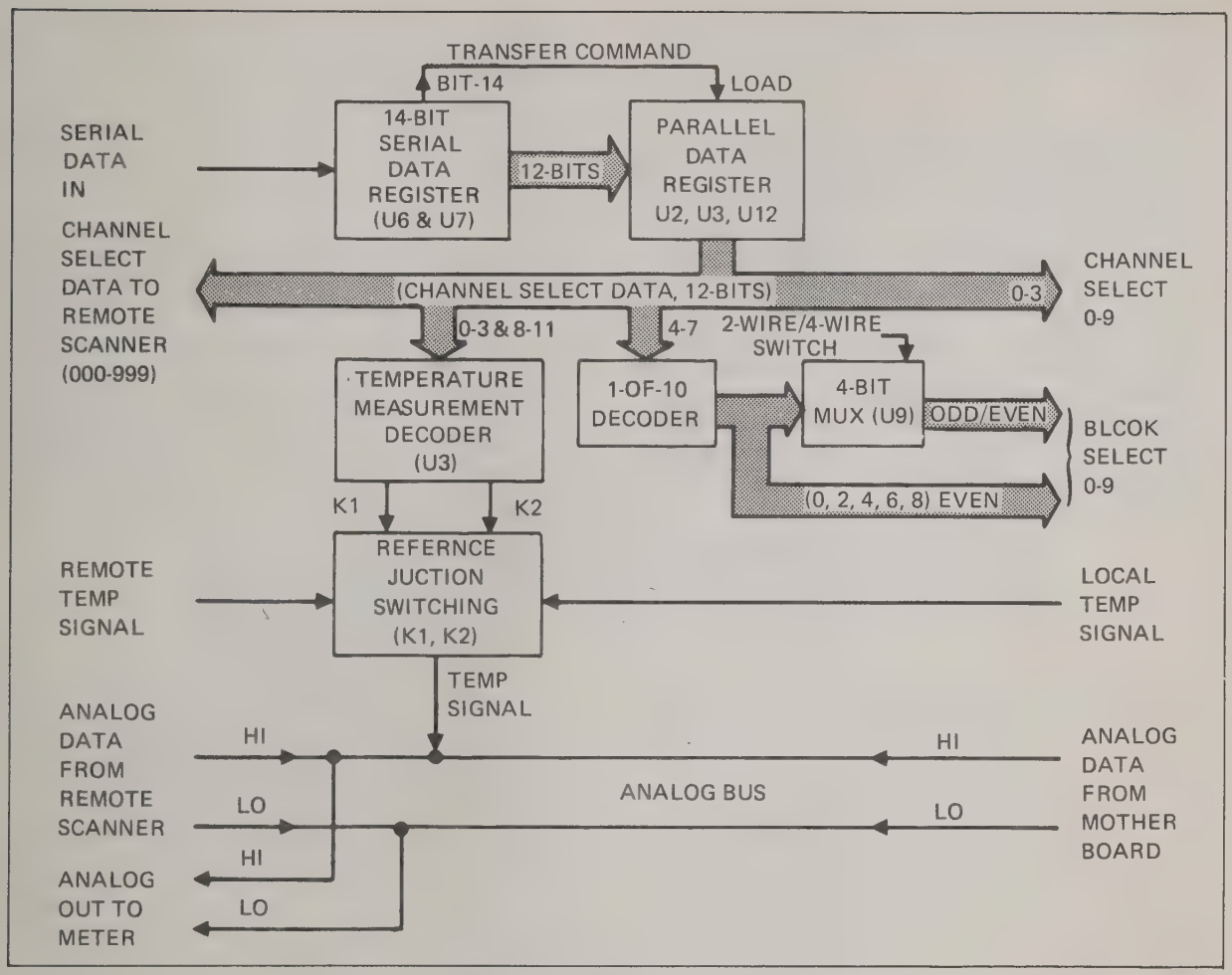


Figure 3-3. Extended Bus PCB Assembly

3-14. Thermocouple temperature measurements are made using special low level scanners. The scanners are equipped with the ability to sample a reference junction plus the standard 10-channel scanning capability. To make an accurate temperature determination both the thermocouple output and the temperature at the thermocouple connections (reference junction) must be measured. The controls needed to accomplish this two step measurement are included on the Extender Bus PCB Assembly in the form of the temperature measurement decoder and two reference junction relays (K1 and K2). Relay K1 selects between local or remote reference temperature signals. Relay K2 is closed when the μC determines the need for a reference junction measurement. This places the local or remote reference as selected by K1 onto the analog bus for measurement purposes. Relay K2 is always open for channel data measurements.

3-15. Measurement data from the selected channel or reference junction (local or remote) is presented to the analog bus on the Extended Bus PCB Assembly. Measurement connections for the external measurement device (DVM) are taken directly from the bus and made available at the rear panel analog output connector P13.

3-16. Power Supply

3-17. The power supply provides the operating voltages for the 2204A with a full complement of scanners. Voltages include +5V for the guarded logic (GL+5V), +5V for the unguarded logic (UL+5V), and the 6.2V reference voltage required for thermocouple temperature measurements.

3-18. Input power for the power supply is derived from a 100/120/200/240V ac transformer with three secondary windings. Transformer line requirements are selectable by changing the position of a plug-in pcb located in the rear panel fuse compartment. A transformer shield isolates two of the output windings. This shield is extended to the power supply pcb and the

2204A mainframe where it is used for signal isolation (guard). Guarded voltages includes GL+5V and +6.2V reference.

3-19. Logic Common for the guarded +5V supply is 15 volts below analog common and guard. This allows FET's on the scanner pcb's to be switched directly. The +6.2V supply uses Reference Common as its ground return. Reference Common is tied directly to A/D Common. The unguarded +5V supply has a floating ground that is referenced to the controller chassis when a controller is used. If a controller is not used, internal zener diodes keep the common from floating. The unguarded common is also accessible at the shell of the Trigger Output connector on the rear of the 2204A. When the Tigger Output is used, the shell (unguarded common) should not be floated more than 30 volts above chassis.

3-20. Conventional regulating techniques are used in both sections of the power supply. Three terminal IC regulators are used for both +5V supplies and no adjustments are provided. The +6.2V supply is adjustable. It uses a unity gain op-amp whose adjustable input is derived from a regulated zener reference.

3-21. Remote Interface Option

3-22. Two remote interface options are available for use with 2204A; the IEEE-488 Interface (Option -060) and the RS-232-C Bit-Serial Interface (Option -050). Both interfaces are receive-only devices. The IEEE-448 Interface conforms to the IEEE-488 Standard and is used to receive character-serial control data. The RS-232-C Interface is used to receive bit-serial input data conforming to the EIA RS-232-C Standard. Theory for each interface assembly is given in Section 6 of this manual.

Section 4
Maintenance

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCITONS UNLESSS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 2204A Scanner including general maintenance and a performance test. The performance test is recommended as an acceptance test when the instrument is first received and later, as a preventative maintenance tool to verify specifications after repair. The 2204A does require one calibration adjustment. Table 4-1 lists the equipment required for servicing the instrument. If the recommmended model is not available, a substitute meeting the minimum use specifications may be used.

Table 4-1. Required Test Equipment

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
DVM*	20V dc range ±0.1% accuracy	Fluke 8000A
Scanner PCB	10-channel	Fluke 2200A-06 or 2204A-310
Test Cable	See Service Tools	Fabricated

*If the 2204A is being maintained in a system's environment, use the system's DVM; typically, a Fluke Model 8502A.

4-3. SERVICE INFORMATION

4-4. The 2204A is warranted for a period of 1-year upon delivery to the original purchaser. The WARRANTY is located on the back of the title page located in the front of this manual.

4-5. Factory Authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included in Section 7 of this manual. If requested, an estimate will be provided to the customer before work is begun on instruments that are beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Cleaning

4-8. Clean the 2204A periodically to remove dust, grease and other contamination. Use the following procedure:

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents to clean the 2204A. They will react with the plastic materials used in the instrument.

1. Clean the front panel and case with a soft cloth dampened with a mild solution of detergent and water.

2. Clean the surface of the pcb's using clean, dry air at low pressure (≤20 psi). If grease is encountered, spray with Freon T.F. Degreaser and remove grime with dry, low-pressure air.

4-9. Access Information

4-10. INTERNAL SWITCHES AND ADJUSTMENTS

4-11. All internal switches and calibration adjustments can be accessed by removing the top cover from the 2204A. The location of the applicable switches and adjustments are shown in Figure 4-1. Switch setting and adjustment procedures are given later in this section of the manual.

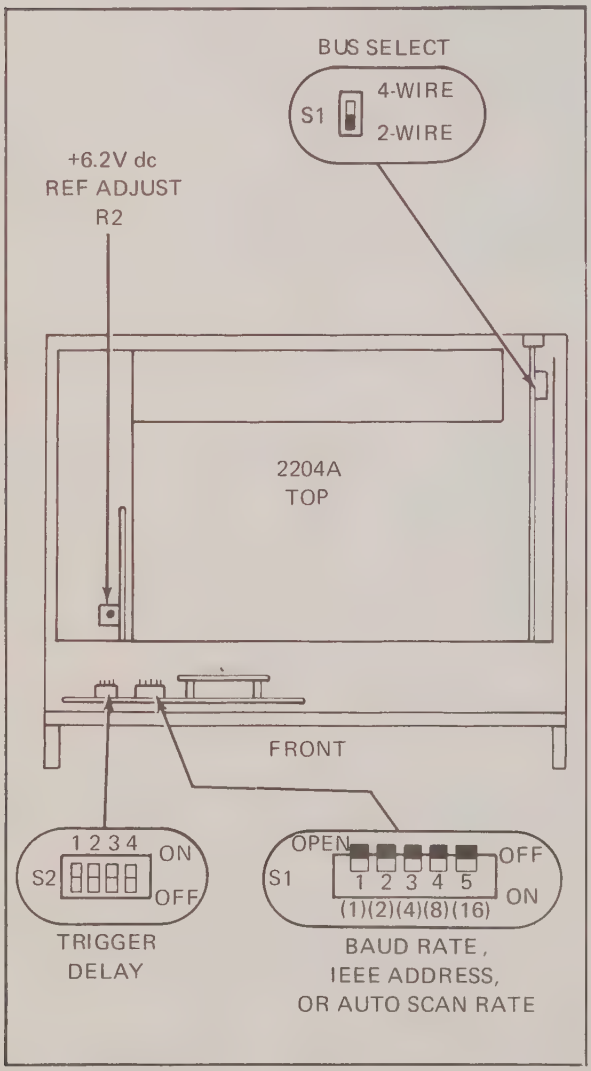


Figure 4-1. Internal Switch and Adjustment Locations

WARNING

TO AVOID ELECTRICAL SHOCK HAZARD REMOVE LINE POWER AND THE SCANNER INPUT CONNECTORS FROM THE 2204A BEFORE REMOVING THE TOP COVER. LETHAL VOLTAGES MAY BE PRESENT AT THE LINE POWER INPUT CONNECTOR AND THE POWER SUPPLY PCB ASSEMBLY WHEN THE 2204A IS CONNECTED TO LINE POWER. LETHAL COMMON MODE VOLTAGES MAY ALSO BE PRESENT AT THE SCANNER INPUT CONNECTORS, EXTENDER CHASSIS, AND SCANNER PCB'S EVEN THOUGH THE LINE POWER CORD IS DISCONNECTED.

4-12. FRONT PANEL DISPLAY PCB ASSEMBLY

4-13. Use the following procedure to access and remove the Front Panel Display PCB Assembly:

1. Remove line power from the 2204A.
2. Remove the top cover from the unit.
3. Remove the three screws along the top side of the Front Panel Display PCB Assembly.
4. Push the pcb away from the front panel (the switch buttons must clear the front panel) and pull the pcb upward.
5. Unplug the attached cables, if necessary.

4-14. Fuse Replacement

4-15. The line fuse is accessible from the rear of the 2204A. Use the following procedure to check and/or replace the fuse.

1. Set the power switch to OFF and disconnect the power cord from the 2204A. The fuse compartment is located just below the power connector.
2. Open the fuse compartment by sliding the see-thru fuse cover toward the power connector.
3. Locate FUSE tab (next to fuse) and gently lift it up. This releases and lifts one end of the fuse.
4. Remove and inspect fuse. If replacement is required, use MDL 1/8 amp fuse for 100/120V ac operation and MDL 1/16 amp fuse for 220/240V ac operation.
5. Lower FUSE tab and press good fuse into the fuse holder.
6. Close fuse compartment and connect power cord.

4-16. Baud Rate Selection

4-17. Baud rate for the RS-232-C Interface is selectable using a series of five lever switches (S1) located on the

back of the Display PCB Assembly. The procedure for accessing and setting these switches follows:

NOTE

If the 2204A is equipped with the IEEE-488 Interface, these switches are used to select a listen address code. See IEEE-Address Selection in next paragraph.

1. Remove the 2204A top cover and locate switch S1 as shown in Figure 4-1.

2. Set all switch levers to the closed (ON) position. This enters a code 0 which is equivalent to 110 baud.

3. Refer to the baud rate codes in Table 4-2 and set the S1 switch levers to the code that corresponds to the desired baud rate.

4. Install the top cover and energize the unit. The display should read b followed by the assigned baud rate code (0-7).

Table 4-2. Baud Rate Selection

BAUD RATE	SWITCH S1					DISPLAY CODE
	1	2	3	4	5	
110	0	0	0	x	x	b-0
134.5	1	0	0	x	x	b-1
150	0	1	0	x	x	b-2
300	1	1	0	x	x	b-3
600	0	0	1	x	x	b-4
1200	1	0	1	x	x	b-5
2400	0	1	1	x	x	b-6
4800	1	1	1	x	x	b-7

1 = OFF (OPEN)
0 = ON (CLOSED)
x = DON'T CARE

4-18. IEEE Address Selection

4-19. The listen address for the IEEE-488 Interface is selectable using a series of five lever switches (S1) located on the back of the Display PCB Assembly. The procedure for accessing and setting these switches follows:

1. Remove the 2204A top cover and locate switch S1 as shown in Figure 4-1.

2. Set all switch levers to the closed (ON) position. This enters a code of 0 which is equivalent to an address of 0.

3. Refer to the list of address codes in Table 4-3 and set the S1 switch levers to match the desired IEEE address.

4. Install the top cover and energize the unit. The display should read A followed by the assigned address code (0-30).

Table 4-3. IEEE Address Selection

IEEE ADDRESS	SWITCH S1					DISPLAY CODE
	1	2	4	3	5	
0	0	0	0	0	0	A-0
1	1	0	0	0	0	A-1
2	0	1	0	0	0	A-2
3	1	1	0	0	0	A-3
4	0	0	1	0	0	A-4
5	1	0	1	0	0	A-5
6	0	1	1	0	0	A-6
7	1	1	1	0	0	A-7
8	0	0	0	1	0	A-8
9	1	0	0	1	0	A-9
10	0	1	0	1	0	A10
11	1	1	0	1	0	A11
12	0	0	1	1	0	A12
13	1	0	1	1	0	A13
14	0	1	1	1	0	A14
15	1	1	1	1	0	A15
16	0	0	0	0	1	A16
17	1	0	0	0	1	A17
18	0	1	0	0	1	A18
19	1	1	0	0	1	A19
20	0	0	1	0	1	A20
21	1	0	1	0	1	A21
22	0	1	1	0	1	A22
23	1	1	1	0	1	A23
24	0	0	0	1	1	A24
25	1	0	0	1	1	A25
26	0	1	0	1	1	A26
27	1	1	0	1	1	A27
28	0	0	1	1	1	A28
29	1	0	1	1	1	A29
30	0	1	1	1	1	A30
31 *	1	1	1	1	1	Err

* = Illegal address, Err = error
1 = OFF (OPEN)
0 = ON (CLOSED)
x = DON'T CARE

4-20. Auto Scan Rate Selection

4-21. The auto scan rate for the 2204A is selectable using the same five-lever switch (S1 located on the back of the Display PCB Assembly) used to select baud rate or the IEEE address. Normally, during remote operation switch S1 defines the baud rate or IEEE address of the remote interface. However, when the auto scan mode is enabled S1 defines the auto scan rate. The procedure for accessing and setting the auto scan switches follows:

1. Remove the 2204A top cover and locate S1 as shown in Figure 4-1.

2. Refer to the list of scan rate codes in Table 4-4 and set the S1 switch levers to match the desired rate.

3. Install the top cover.

Table 4-4. Auto Scan Rate Selection

RATE IN SEC/CHANNEL	SWITCH S1				
	1	2	3	4	5
0.2	0	0	0	0	0
0.3	1	0	0	0	0
0.4	0	1	0	0	0
0.5	1	1	0	0	0
0.6	0	0	1	0	0
0.7	1	0	1	0	0
0.8	0	1	1	0	0
0.9	1	1	1	0	0
1.0	0	0	0	1	0
1.1	1	0	0	1	0
1.2	0	1	0	1	0
1.3	1	1	0	1	0
1.4	0	0	1	1	0
1.5	1	0	1	1	0
1.6	0	1	1	1	0
1.7	1	1	1	1	0
1.8	0	0	0	0	1
1.9	1	0	0	0	1
2.0	0	1	0	0	1
2.1	1	1	0	0	1
2.2	0	0	1	0	1
2.3	1	0	1	0	1
2.4	0	1	1	0	1
2.5	1	1	1	0	1
2.6	0	0	0	1	1
2.7	1	0	0	1	1
2.8	0	1	0	1	1
2.9	1	1	0	1	1
3.0	0	0	1	1	1
3.1	1	0	1	1	1
3.2	0	1	1	1	1
3.3*	1	1	1	1	1

* = Err displayed on turn on

1 = OFF (OPEN) 0 = ON (CLOSED)

4-22. Two-/Four-Wire Bus Selection

4-23. An internal slide switch (S1) on the Extender Bus PCB Assembly allows selection of either a two-wire bus or a four-wire bus for all 2204A measurements. The procedure for accessing and setting the switch follows:

1. Remove the 2204A top cover and locate the two-/four-wire switch as shown in Figure 4-1.

2. Set the switch to the desired bus configuration; forward for two-wire, toward the rear of the unit for four-wire.

4-24. Trigger Delay Selection

4-25. The elapsed time between channel selection and the trigger output pulse can be manually selected by way of switch S2 on the Front Panel PCB Assembly. The procedure for accessing and setting this switch follows:

1. Remove the 2204A top cover and locate switch S2 as shown in Figure 4-1.

2. Set the four switches to the off position. This selects the longest time delay (≈14 mS), pattern 7.

3. Refer to the list of delay patterns given in Table 4-5 and set S2 to match the desired delay. Pattern 7 is recommended for use with the Low Level Scanner (Option -060), and pattern 1 is recommended for use with the General Purpose Scanner (Option -050). If a combination of both scanner is used, pattern 7 is recommended.

4. Install the top cover.

4-26. Service Tools

4-27. A special interface cable is required to execute the performance test given later in this section. The cable is fabricated using either of the available input connectors (Option -07 or -08), two 24-inch lengths of 20-gauge insulated copper wire (red, black) a series of ten 1/4 Watt, ±1% resistors and a 36-pin male connector (John Fluke Part Number 417378). Fabrication details are given in Figure 4-2.

4-28. PERFORMANCE TEST

4-29. The performance test is designed to verify the overall operation of the 2204A, and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 4-1. If the 2204A fails any part of the performance test, corrective action is required.

Table 4-5. Trigger Delay Selection

DELAY PATTERN	SWITCH S2*			DELAY IN ms		
	1	2	3	OFF	ON	LOGIC
0	0	0	0	2	2	2
1	1	0	0	4	2	2
2	0	1	0	6	2	2
3	1	1	0	8	2	2
4	0	0	1	2	4	2
5	1	0	1	4	4	2
6	0	1	1	6	4	2
7	1	1	1	8	4	2

*0 = ON
1 = OFF
Switch 4 to either setting

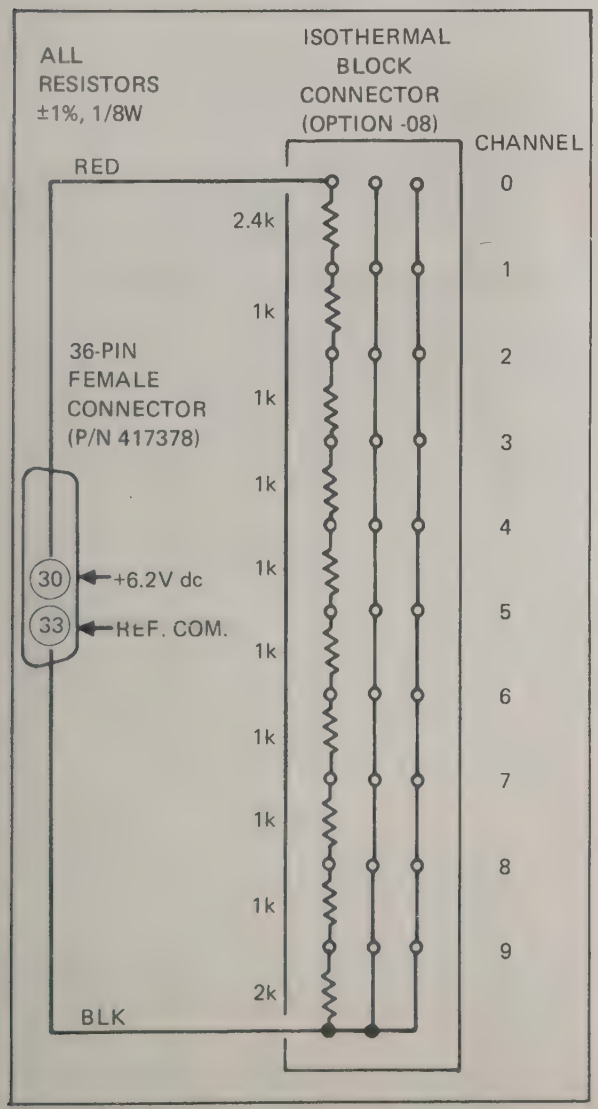


Figure 4-2. Test Cable

4-30. Set-Up Procedure

4-31. Before attempting to execute any of the performance test procedures complete the following set-up procedure:

1. Disconnect the 2204A from the line power.

2. Install a scanner pcb (Option -050 or -060) in block 0 (channels 0-9) of the 2204A. The top cover, rear cover and inner scanner cover should be removed for the duration of the performance test.

3. Remove all scanners and input connectors from the remaining blocks.

4. Attach the test cable described earlier under Service Tools to the scanner in block 0. Connect the cable connector to rear panel EXTENDER CABLE I/O port.

5. Select the two-wire configuration by setting the slide switch on the Extender Bus PCB to the forward position.

6. Connect a DVM to the 2204A (use a two-wire bus) by way of the rear panel ANALOG CABLE OUTPUT connector.

7. Set the DVM to the 20V dc range.

8. Connect the 2204A to line power and press the POWER switch to ON. The channel display should indicate the assigned baud rate (b0-b7) or the assigned IEEE address (A0 thru A31), as applicable.

4-32. Manual Test Procedure

4-33. The following procedure is used to manually test the overall operation of the 2204A.

1. Using the DATA keyboard, manually call channel 0 (press 0 and ENTER). The DVM display should read 6.200 ±0.001V dc. If the voltage is out of tolerance the supply must be adjusted. See CALIBRATION ADJUSTMENTS later in this section.

2. Press the INCREMENT switch. The display should advance to 1 and the DVM should now read 5.00 ±.05V dc.

3. Scan channels 2 through 9 using the INCREMENT switch. The DVM reading at each channel should be as follows:

	CHANNEL	Vdc READING
a.	0	6.200 ±0.001
b.	1	5.00 ±0.05
c.	2	4.50 ±0.05
d.	3	4.00 ±0.05
e.	4	3.50 ±0.04
f.	5	3.00 ±0.03
g.	6	2.50 ±0.03
h.	7	2.00 ±0.03
i.	8	1.50 ±0.03
j.	9	1.00 ±0.03

4. Set the POWER switch to OFF and move the test cable and scanner pcb to block 1.

5. Energize the 2204A and manually scan channels 10 through 19. The DVM readings should agree with those shown in step 3 of this procedure.

6. Using the above procedure (steps 4 and 5) check the operation of scanner blocks 3 through 9.

7. With the scanner in block 9, press 90 followed by T.C. REF JUNCTION. The CHANNEL DISPLAY should read between 0.4 and 0.6V dc.

4-34. Baud Rate/IEEE Address

4-35. The following procedure tests the operation of the baud rate/IEEE address switch S1. Switch S1 is a set of five switches located on the Front Panel PCB Assembly. The switches are accessible when the 2204A's top cover is removed.

1. Set the 2204A POWER switch to OFF.

2. Set all five S1 switches to the ON (closed) position.

3. Set the POWER switch the ON. The display should read A0 if the IEEE Interface is installed or b0 for the RS-232-C Interface.

4. Verify the remaining switch positions as follows:

a. If the IEEE Interface is installed, sequentially set switches 1 through 5 to the open position. Switch power off and on at each setting and observe the display. The reading for each setting should agree with the following list.

Switch:	1	2	3	4	5
Display:	A1	A2	A4	A8	A16

b. If the RS-232-C Interface is installed, sequentially set switches 1 through 3 (4 and 5 are not used) to the open position. Switch power off and on at each setting and observe the display. The reading for each setting should agree with the following list.

Switch:	1	2	3
Display:	b1	b2	b4

4-36. Remote Test Procedure

4-37. The following procedure is used to test the remote interface portion of the 2204A. Refer to Section 2 of this manual for programming information. See Section 6 for interface requirements of the IEEE-488 and RS-232-C remote interface options.

1. Perform the set-up procedure given earlier in this section.

2. Select the appropriate baud-rate/IEEE address using the procedure described earlier in this section.

3. Refer to the Manual Test Procedure given earlier in this section and execute it using remote commands.

4-38. CALIBRATION ADJUSTMENTS

4-39. The 2204A is equipped with on calibration adjustment, R2 on the Power Supply PCB. See Figure 4-1. This potentiometer is used to adjust the +6.2V dc reference voltage used in making thermocouple temperature measurements. Use the following procedure to adjust R2.

1. Complete the set-up procedure given earlier in this section under Performance Test.

2. Using the DATA keyboard, manually call channel 0 (press 0 and ENTER). The DVM should read 6.200 ±0.001V dc. If the voltage is out of tolerance, adjust R2 for a reading of 6.200V dc.

4-40. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components contained in the 2204A.

4-41. When troubleshooting or repairing the 2204A use the following precautions to prevent damage from static discharge:

1. Never remove, install or otherwise connect or disconnect components or pcb's without first setting the 2204A POWER switch to OFF.

2. Perform all repairs at a static-free work station.

3. Do not handle IC's or pcb's by their connectors.

4. Use static ground straps to discharge repair personnel.

5. Use conductive foam to store replacement or removed IC's.

6. Remove all plastic, vinyl and styrofoam products from the work area.

7. Use a grounded soldering iron.

4-42. A troubleshooting guide for the 2204A is given in Table 4-6. To properly use the guide, complete the performance test given earlier in this section and note any discrepancies. Then locate the heading of the procedure in question in the Test and Symptom column (Table 4-6). Under that heading isolate the symptom that approximates the observed malfunction. Possible causes are listed to the right of the selected symptom. Details necessary to isolate a particular cause can be derived from the theory of operation in Section 3 and the schematic diagrams in Section 8 of this manual.

Table 4-6. Troubleshooting Guide

TEST AND SYMPTOM	POSSIBLE CAUSE
Set-Up Procedure	
Dispiay Blank	Fuse, power supply, power supply cable and connections, system clock, microcomputer U6.
Manual Test Procedure	
Channels 0 thru 9	
No +6.2V reading	Power Supply, Extender PCB Assembly, Motherboard.
+6.2V reads OK; one or more of other voltages are incorrect	Extender PCB channel select logic, Motherboard.
Some block slots are OK others are not	Extender Bus PCB block select logic, Motherboard.
Baud Rate/IEEE-Address	All baud rate/IEEE address malfunctions can be isolated to the Front Panel Display PCB Assembly.
Remote Test Procedure	Remote interface cable and/or remote interface pcb assembly.

Section 5
List of Replaceable Parts

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5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alpha-numerically by assembly. Electrical and mechanical components are listed by reference designation. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation or Item Number.

2. Description of each part.

3. Fluke Stock Number.

4. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)

5. Manufacturer's Part Number or Type.

6. Total Quantity per assembly or component.

7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc, that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

8. Use Code is not used.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc., factory or authorized representative by using the Fluke Stock Number. In the event the part your order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity.

2. Fluke Stock Number.

3. Description.

4. Reference designation or item number.

5. Printed circuit board part number and revision letter.

6. Instrument model and serial number.

⊗ CAUTION

Indicated devices are subject to damage by static discharge.

Table 5-1. 2204A Final Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, MODEL 2204A FIGURE 5-1						
A1	FRNT PANEL DISPLAY PCB ASSY, 2204A-4010T	468066	89536	468066	1		
A2	CHASSIS ASSEMBLY	468082	89536	468082	1		
H1	POWER CORD	284174	89536	284174	1		
H2	SEAL, O-RING	146696	89536	146696	1		
H3	SCREW, 6-32 X 1/4	320093	89536	320093	6		
H4	SCREW W/LOCKWASHER, 6-32 X 3/8	177022	89536	177022	8		
MP1	COVER, TIP	419523	89536	419523	1		
MP2	COVER, RIGHT-SIDE	414920	89536	414920	1		
MP3	COVER, LEFT-SIDE	414938	89536	414938	1		
MP4	COVER, REAR	440503	89536	440503	1		
MP5	CHAMBER, GUARD, TOP	467894	89536	467894	1		
MP6	DECAL, FRONT PANEL	472993	89536	472993	1		
MP7	DECAL, REAR PANEL	467928	89536	467928	1		
MP8	DECAL, SIDE TRIM	295402	89536	295402	1		
MP9	DECAL, OPTION	468140	89536	468140	1		
MP10	DECAL, COVERS	394403	89536	394403	4		
MP11	BUTTON, POWER, GREEN	467910	89536	467910	1		
MP12	POWER BUTTON ASSEMBLY	401646	89536	401646	1		
MP13	CABLE, POWER	475574	89536	475574	1		
MP14	CABLE, EXTENDED BUS	468116	89536	468116	1		
MP15	CABLE, INTERCONNECTING	468611	89536	468611	1		

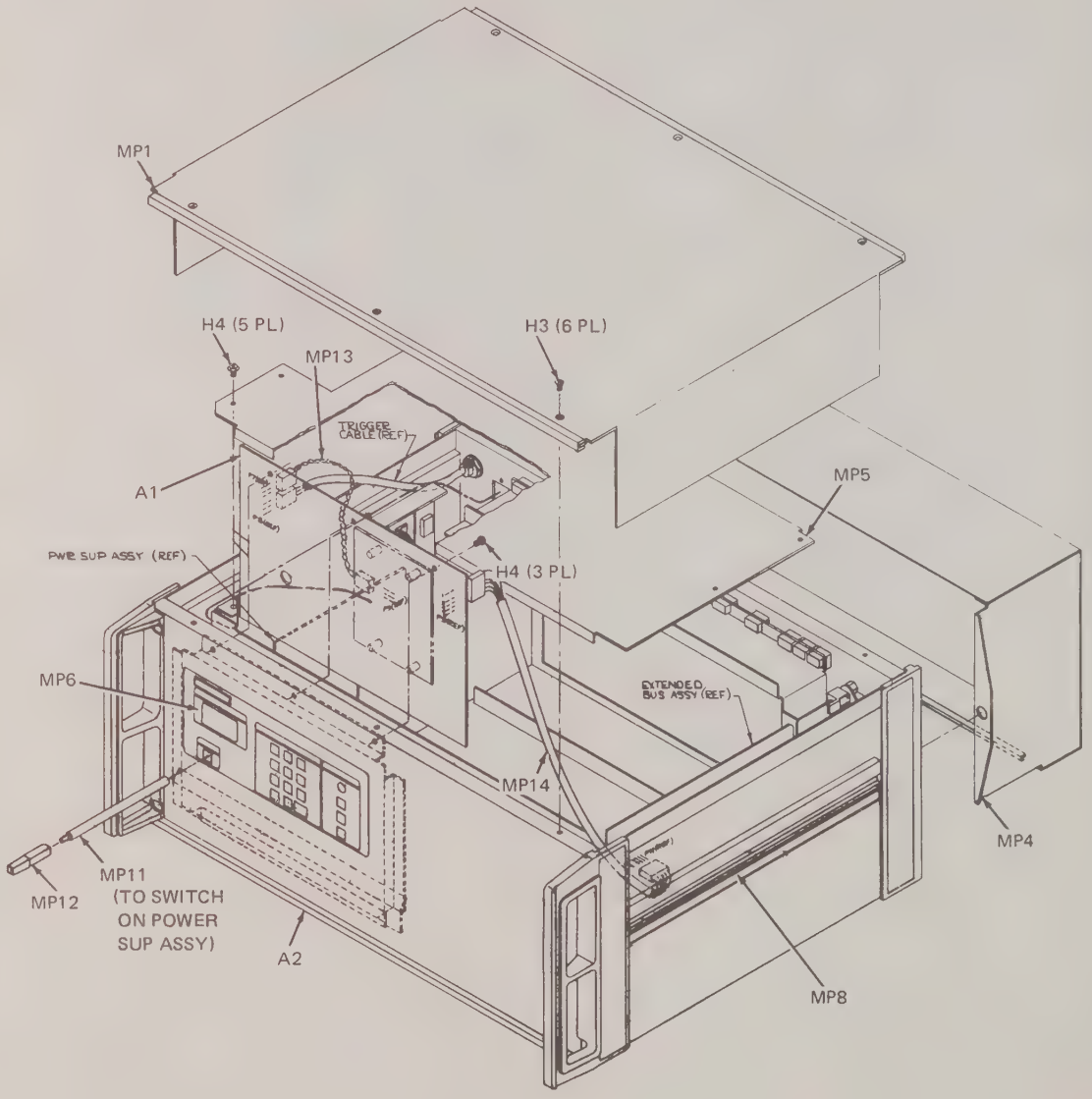

Figure 5-1. 2204A Final Assembly

Table 5-2. A1 Front Panel Display PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	FRNT PANEL DISPLAY PCB ASSY (2204A-4010) FIGURE 5-2	468066	89536	468066	REF		
C1	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0025KA1	4		
C2	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0025KA1	REF		
C3	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0025KA1	REF		
C4	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0025KA1	REF		
C5	CAP, MICA, 22 PF +/-5%, 500V	148551	72136	DM15C220J	2		
C6	CAP, MICA, 22 PF +/-5%, 500V	148551	72136	DM15C220J	REF		
C7	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0035JA1	1		
C8	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	1		
CR1	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	5	1	
CR2	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR3	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR4	DIODE, INDICATOR, LED	413831	29083	MV5153	1	1	
CR5	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR6	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR7	DIODE, ZENER, 36V	186163	07910	1N974B	2	1	
CR8	DIODE, ZENER, 36V	186163	07910	1N974B	REF		
DS1	DIODE, LED, 7-SEGMENT	468124	89536	468124	3	1	
DS2	DIODE, LED, 7-SEGMENT	468124	89536	468124	REF		
DS3	DIODE, LED, 7-SEGMENT	468124	89536	468124	REF		
H1	WASHER, INS, TEFLON	195354	89536	195354	4		
P7	PINS, CONNECTOR, MALE	267500	00779	87022-1	15		
P8	PINS, CONNECTOR, MALE	267500	00779	87022-1	REF		
P9	PINS, CONNECTOR, MALE	267500	00779	87022-1	REF		
P10	CONNECTOR, FEMALE, 12-PIN	447813	22526	65501-136	2		
Q1	XSTR, SI, PNP	195974	04713	2N3906	3	1	
Q2	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q3	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q4	XSTR, SI, NPN	218396	04713	2N3904	1	1	
R1	RES, DEP. CAR, 390 +/-5%, 1/4W	441543	80031	CR251-4-5P390E	2		
R2	RES, DEP. CAR, 390 +/-5%, 1/4W	441543	80031	CR251-4-5P390E	REF		
R3	RES, DEP. CAR, 5.6K +/-5%, 1/4W	442350	80031	CR251-4-5P5K6	4		
R4	RES, DEP. CAR, 5.6K +/-5%, 1/4W	442350	80031	CR251-4-5P5K6	REF		
R5	RES, DEP. CAR, 5.6K +/-5%, 1/4W	442350	80031	CR251-4-5P5K6	REF		
R6	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	3		
R7	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R8	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R9	RES, DEP. CAR, 2K +/-5%, 1/4W	441469	80031	CR251-4-5P2K	1		
R10	RES, DEP. CAR, 5.6K +/-5%, 1/4W	442350	80031	CR251-4-5P5K6	REF		
R11	RES, DEP. CAR, 24 +/-5%, 1/4W	442210	80031	CR251-4-5P24E	1		
R12	RES, DEP. CAR, 10 +/-5%, 1/4W	340075	80031	CR251-4-5P10E	1		
S1	SWITCH, PIANO, 5 PST	454769	00779	435802-4	1		
S2	SWITCH, DIP, 4 PST	408559	00779	435166-2	1		
S3	SWITCH ASSY, PUSHBUTTON						
	PUSHBUTTON, BLUE (0)	406736	89536	406736	1		
	PUSHBUTTON, WHITE (1 THRU 9, 14)	406744	89536	406744	10		
	PUSHBUTTON, GREY (10 THRU 12)	401307	89536	401307	3		
	PUSHBUTTON, ORANGE (13)	420620	89536	420620	1		
	COVER, SWITCH	401299	89536	401299	15		

Table 5-2. A1 Front Panel Display PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	CONTACT, FIXED	416875	00779	62313	15		
	SPRING	414516	00779	63212	15		
	ACTUATOR, SWITCH	412106	89536	412106	15		
U1	IC, 8-RESISTOR NETWORK, 180	424531	89536	424531	1	1	
U2	IC, TTL, BUFFERS, INTERFACE GATES	407593	01295	SN7406N	2	1	
U4	IC, TTL, SCHOTTKY "D" TYPE, FLIP-FLOP	454892	01295	SN74LS273N	1	1	
U5	IC, TTL SCHOTTKY TRI-STATE, OCTAL BUFFER	429902	12040	DM81LS95N	1	1	
U7	ISOLATOR, OPT-CPLD, DUAL, HI-SPEED	429894	28480	5082-4355	1	1	
U8	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	1	1	
U9	IC, TTL, QUAD, 2-INPUT, POS OR GATES	393108	01295	SN74LS32N	1	1	
U10	IC, TTL SCHOTTKY DUAL "D" CLEAR & PRESET	393124	01295	SN74LS74N	1	1	
U11	IC, 8-RESISTOR NETWORK, 680	402644	89536	402644	1	1	
XDS1	SOCKET, IC, DIP, 14-PIN	453514	23880	T3800-14B	3		
XDS2	SOCKET, IC, DIP, 14-PIN	453514	23880	T3800-14B	REF		
XDS3	SOCKET, IC, DIP, 14-PIN	453514	23880	T3800-14B	REF		
XU6	SOCKET, IC, DIP, 40-PIN	386060	09922	D1LB40P-1	1		
XU7	SOCKET, IC, DIP, 8-PIN	478016	91506	308-AG39D	1		

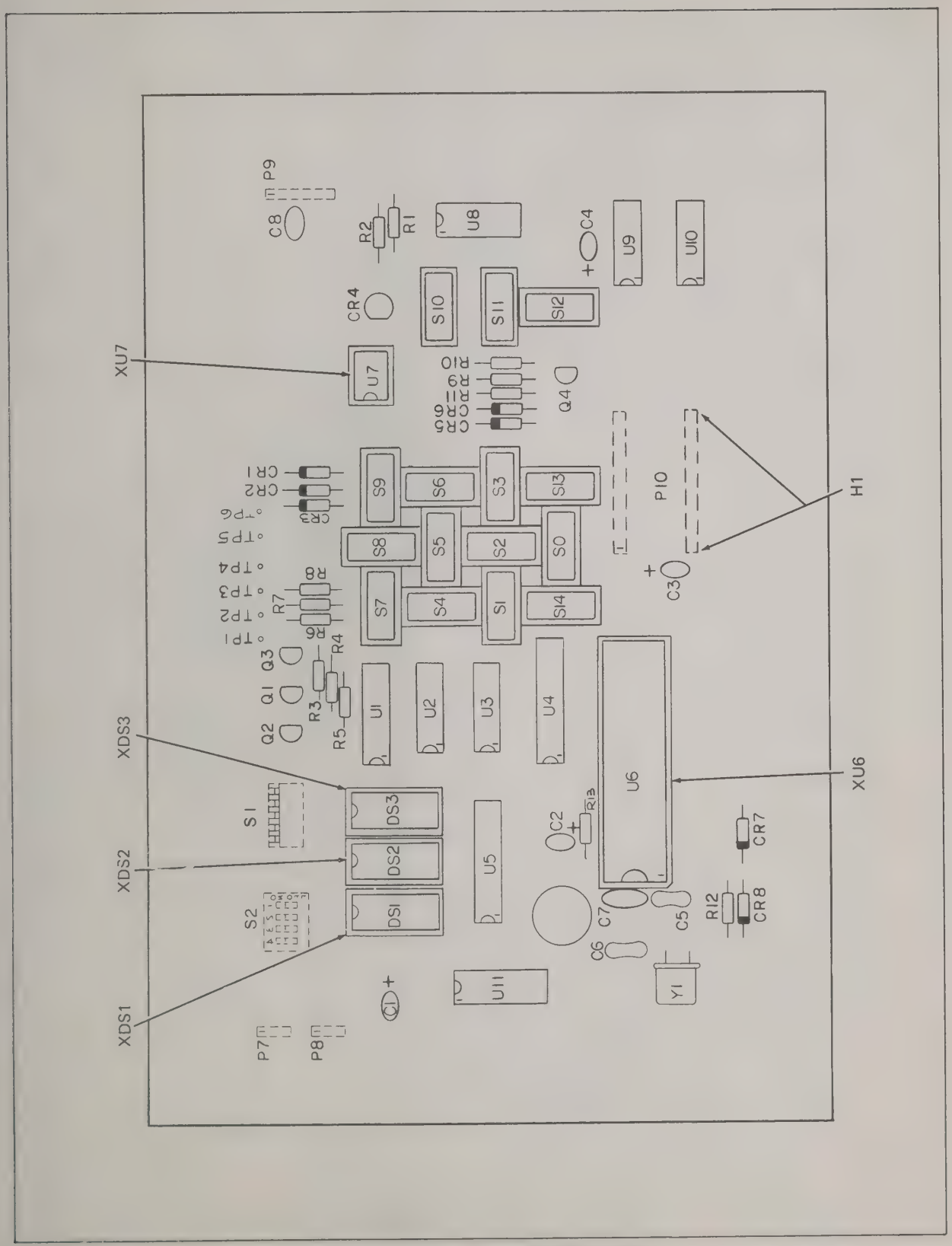

Figure 5-2. Front Panel Display PCB Assembly

Table 5-3. A2 Chassis Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	CHASSIS ASSEMBLY (2204A-4201) FIGURE 5-3						
A2A1	MOTHER BOARD PCB ASSY (2204A-4001T)	468132	89536	468132	1		
A2A2	EXTENDED BUS PCB ASSY (2204A-4015T)	468074	89536	468074	1		
A2A3	POWER SUPPLY PCB ASSY (2204A-4005T)	468058	89536	468058	1		
H1	GUIDE, CARD	256461	89536	256461	10		
H2	BINDING POST	225615	20584	3575	1		
H3	BINDING POST, BRASS	225623	20584	3576	1		
H4	SCREW, 6-32 X 1/2	177030	89536	177030	4		
H5	SCREW, 6-32 X 1/4	320093	89536	320093	10		
H6	SCREW, 4-40 X 1/4	185918	89536	185918	16		
H7	SCREW, 6-32 X 3/8	177022	89536	177022	22		
H8	SCREW, 8-32 X 3/8	114116	89536	114116	8		
H9	SCREW, 8-32 X 1/2	114355	89536	114355	10		
H10	SCREW, SOCKET HEAD, 8-32	295105	89536	295105	4		
H11	BUSHING NYLON	339978	89536	339978	1		
H12	WASHER, LOCK, 1/4	110817	89536	110817	1		
H13	NUT, 1/4 X 28	110619	89536	110619	1		
H14	SCREW, 2-56 X 5/8	370270	89536	370270	4		
H15	NUT, 2-56	110668	89536	110668	4		
H16	WASHER, LOCK, #2	110676	89536	110676	4		
J1	CONNECTOR, LINE POWER	461269	89536	461269	1		
MP1	FRONT PANEL ASSY	468892	89536	468892	1		
MP2	REAR PANEL	467878	89536	467878	1		
MP3	CHASSIS SIDE	419580	89536	419580	2		
MP4	BRACKET, SUPPORT, ISOTHERMAL	440529	89536	440529	1		
MP5	CHAMBER, GUARD	467944	89536	467944	1		
MP6	BOTTOM, CHAMBER, GUARD	467951	89536	467951	1		
MP7	BRACKET, POWER SUPPLY	467886	89536	467886	1		
MP8	BRACKET, GUARD	468686	89536	468686	1		
MP9	RETAINER, CARD	468660	89536	468660	1		
MP10	CORNER	471375	89536	471375	2		
MP11	HANDLE, FRONT	394320	89536	394320	2		
MP12	COVER, BOTTOM	419515	89536	419515	1		
MP13	FOOT, PLASTIC	292870	89536	292870	4		
MP14	GUIDE, CARD	298836	89536	298836	30		
MP15	SPACER	372334	89536	372334	26		
MP16	INSULATOR	372342	89536	372342	26		
T1	TRANSFORMER, POWER	487462	89536	487462	1		
W1	CABLE, TRIGGER	467936	89536	467936	1		
W2	CABLE, ANALOG INPUT	475566	89536	475566	1		
W3	CABLE, LINE CORD	468108	89536	468108	1		

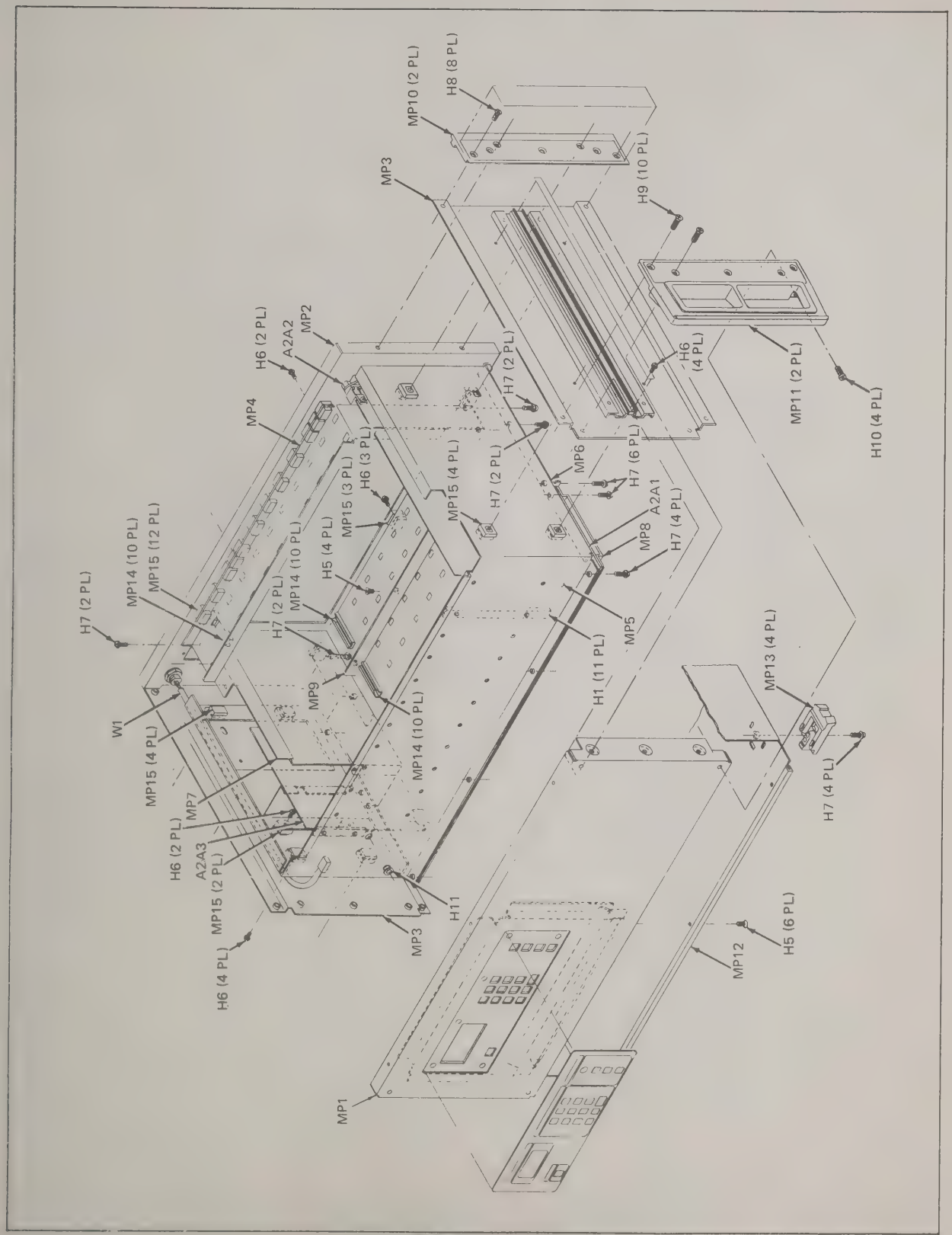

Figure 5-3. A2 Chassis Assembly

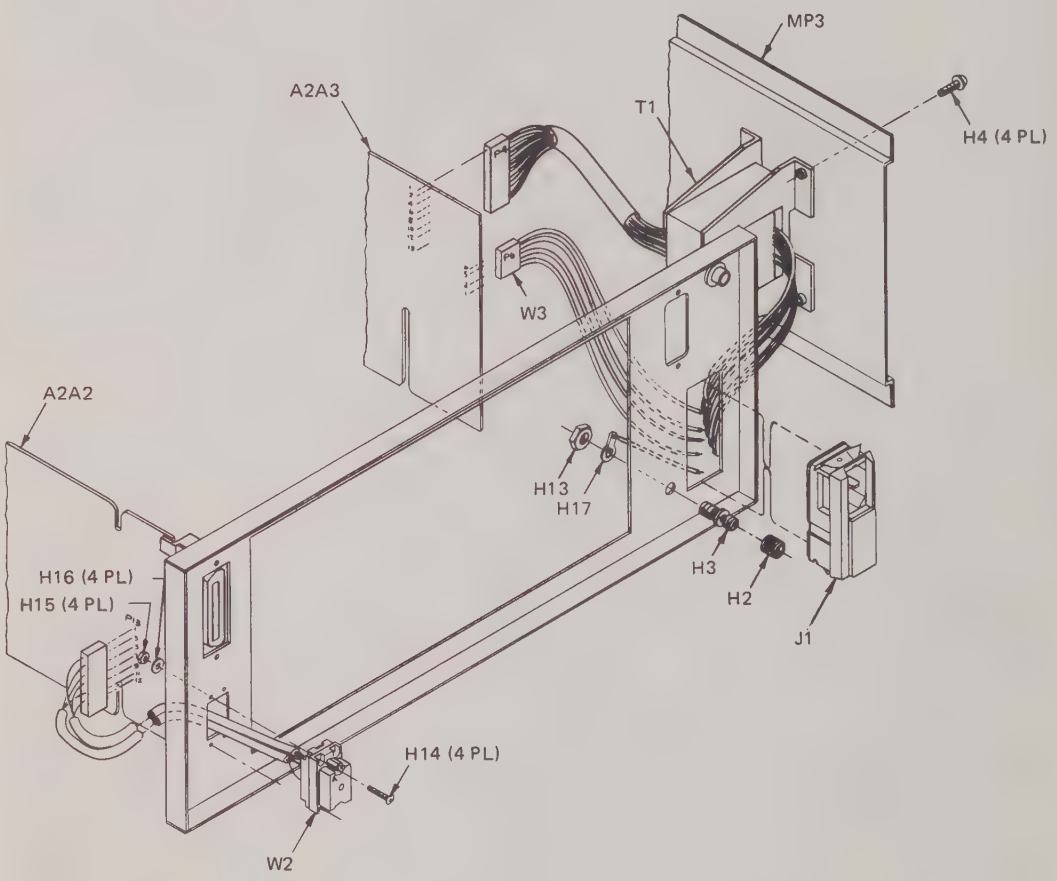

Figure 5-3. A2 Chassis Assembly (cont)

Table 5-4. A2 A1 Mother Board PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2A1	MOTHER BOARD PCB ASSY (2204A-4001) FIGURE 5-4	468132	89536	468132	REF		
C1	CAP, MYLAR, 3000 PF +/-10%, 600V	479469	14655	DMF6D33	1		
H1	KEY, POLARIZING, CONNECTOR	293498	89536	293498	33		
J1	CONNECTOR, CARD EDGE, 8-PIN	354951	00779	583407-5	1		
J2	CONNECTOR, CARD EDGE, 24-PIN	295352	00779	583650-9	1		
J3	CONNECTOR, CARD EDGE, 6-PIN	291625	00779	583650-1	1		
R1	RES, COMP, 1.5M +/-5%, 1/2W	108175	01121	EB1555	1		
	CONNECTORS, SLOTS 0 THRU 9						
XP11	12-PIN CONNECTOR	291898	00779	583650-2	10		
XP12	6-PIN CONNECTOR	291625	00779	583650-1	10		

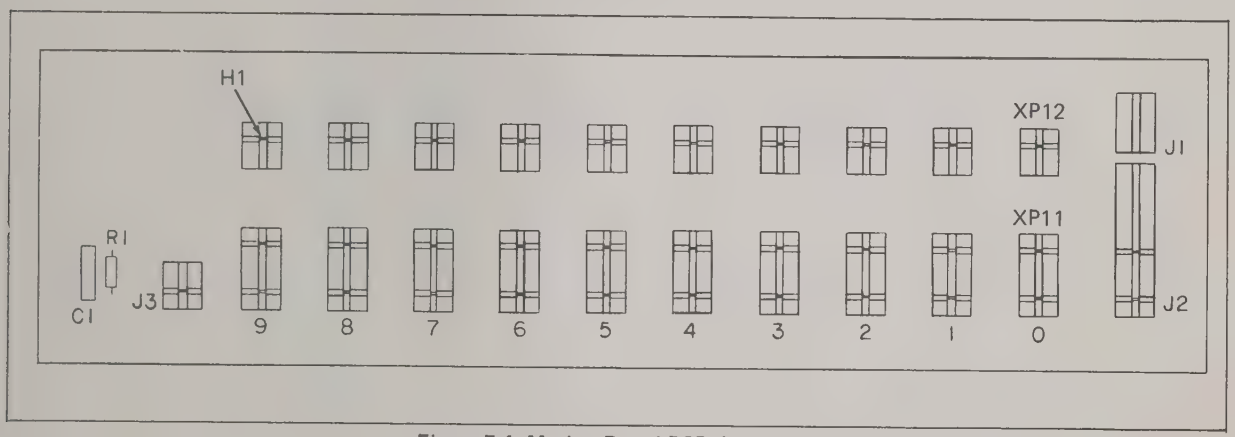

Figure 5-4. Mother Board PCB Assembly

Table 5-5. A2A2 Extended PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2A2	⊗ EXTENDED BUS PCB ASSY (2204A-4015) FIGURE 5-5	468074	89536	468074	REF		
C1	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	6		
C2	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C3	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C4	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C5	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
C6	CAP, TA, 2.2 UF +/-20%, 20V	161927	56289	196D225X0020HA1	REF		
CR1	DIODE, SI	203323	07910	1N4448	2	1	
CR2	DIODE, SI	203323	07910	1N4448	REF		
H1	SCREW, 4-40 X 3/8	152124	73734	19024	2		
H2	WASHER, LOCK, #4	110395	89536	110395	2		
H3	NUT, HEX, 4-40	147611	89536	147611	2		
H4	LUG, SOLDER	151431	79963	329	1		
H5	WASHER, FLAT	111310	89536	111310	4		
H6	KIT, CONNECTOR	448563	89536	448563	1		
J12	CONNECTOR, FEMALE, 36-PIN	414409	00779	552241-1	1		
K1	RELAY, DRY REED, DPST	442921	21317	052A5*300BAA	2		
K2	RELAY, DRY REED, DPST	442921	21317	052A5*300BAA	REF		
P11	PINS, CONNECTOR, MALE	267500	00779	87022-1	12		
P13	PINS, CONNECTOR, MALE	267500	00779	87022-1	REF		
Q1	XSTR, SI, NPN	218396	04713	2N3904	2	1	
Q2	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, DEP. CAR, 3.3K +/-5%, 1/4W	348813	80031	CR251-4-5P3K3	2		
R2	RES, DEP. CAR, 3.3K +/-5%, 1/4W	348813	80031	CR251-4-5P3K3	REF		
R3	RES, DEP. CAR, 2.2K +/-5%, 1/4W	343400	80031	CR251-4-5P2K2	2		
R4	RES, DEP. CAR, 2.2K +/-5%, 1/4W	343400	80031	CR251-4-5P2K2	REF		
R5	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	1		
S1	SWITCH, SLIDE, SPDT	477984	34328	GS115G20-52	1		
U1	⊗ IC, MOS, HEX INVERTER	381848	02735	CD4049AE	1	1	
U2	IC, TTL, QUAD, D-TYPE FLIP-FLOP	452912	12040	MM74C175N	3	1	
U3	IC, TTL, QUAD, D-TYPE FLIP-FLOP	452912	12040	MM74C175N	REF		
U4	⊗ IC, MOS, HEX BUFFER	381830	02735	CD4050AE	4	1	
U5	⊗ IC, MOS, QUAD, 2-INPUT AND GATE	408401	02735	CD4081AE	1	1	
U6	⊗ IC, MOS, DUAL 4-STAGE SHIFT REGISTER	340125	04713	MC14015BCP	2	1	
U7	⊗ IC, MOS, DUAL 4-STAGE SHIFT REGISTER	340125	04713	MC14015BCP	REF		
U8	⊗ IC, MOS, HEX BUFFER	381830	02735	CD4050AE	REF		
U9	⊗ IC, MOS, QUAD, AND/OR SELECT GATE	419010	02735	CD4019AE	1	1	
U10	⊗ IC, MOS, BCD-TO-DECIMAL DECODER	473769	04713	MC14028B	1	1	
U11	⊗ IC, MOS, QUAD, 2-INPUT OR GATE	408393	02735	CD4071BE	1	1	
U12	IC, TTL, QUAD, D-TYPE FLIP-FLOP	452912	12040	MM74C175N	REF		
U13	⊗ IC, MOS, DUAL, 4-INPUT NOR GATE	363820	02735	CD4002AE	1	1	
U14	⊗ IC, MOS, HEX BUFFER	381830	02735	CD4050AE	REF		
U15	⊗ IC, MOS, HEX BUFFER	381830	02735	CD4050AE	REF		

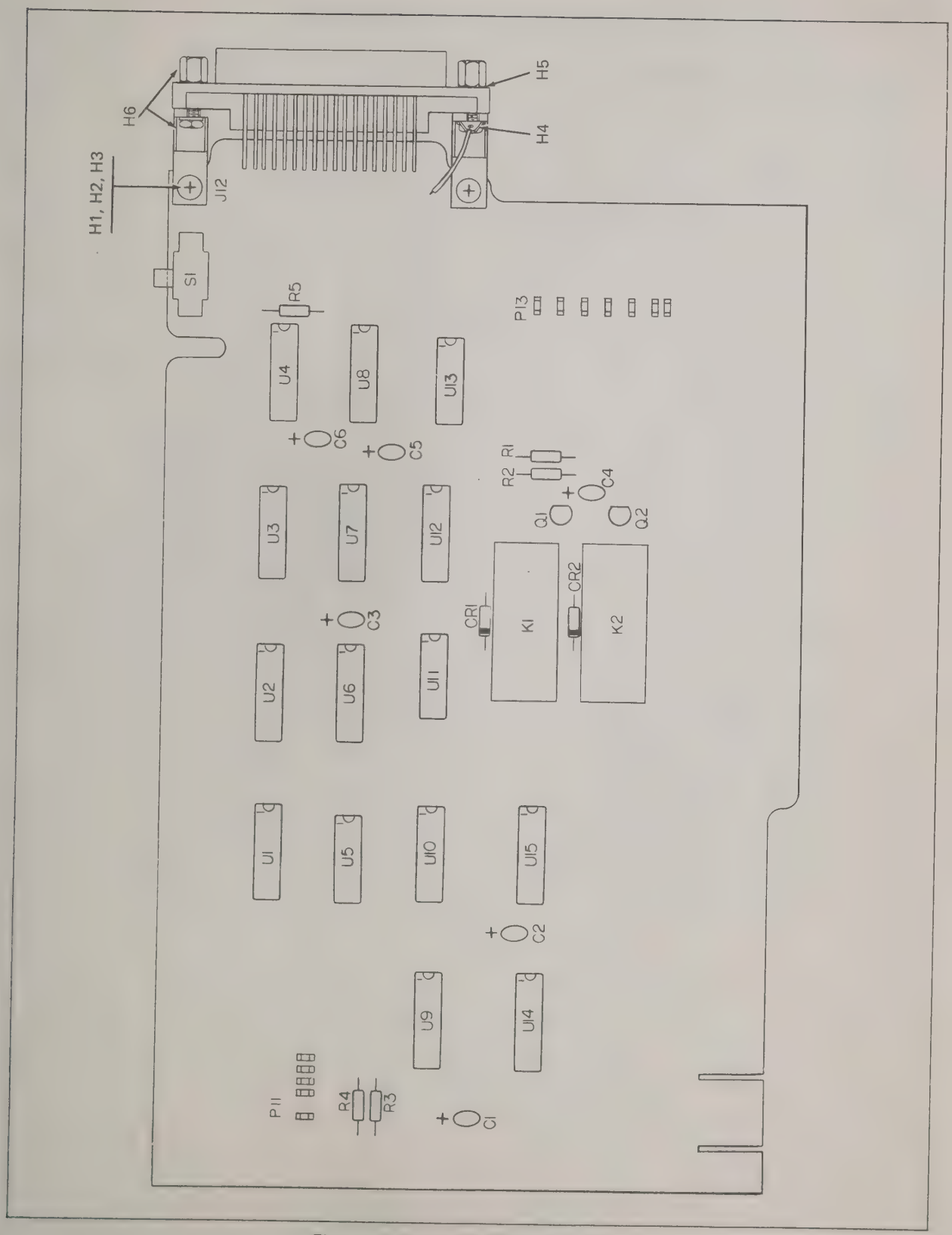

Figure 5-5. Extended Bus PCB Assembly

Table 5-6. A2A3 Power Supply PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2A3	POWER SUPPLY PCB ASSY (2204A-4005) FIGURE 5-6	468058	89536	468058	1		
C1	CAP, ELECT, 2200 UF -10/+100%, 25V	392720	80031	3050HJ222U025	2	1	
C2	CAP, ELECT, 220 UF -10/+50%, 40V	178616	80031	ET221X040A01	2	1	
C3	CAP, ELECT, 220 UF -10/+50%, 40V	178616	80031	ET221X040A01	REF		
C4	CAP, ELECT, 2200 UF -10/+100%, 25V	392720	80031	3050HJ222U025	REF		
C5	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0025KA1	2		
C6	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0025KA1	REF		
C7	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J	1		
C8	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0035JA1	2		
CR1	RECTIFIER, BRIDGE, 1 AMP	418582	83003	VM08	2	1	
CR2	RECTIFIER, BRIDGE, 1 AMP	418582	83003	VM08	REF		
CR3	RECTIFIER, BRIDGE	296509	21845	F903G-22	1	1	
CR4	REFERENCE SET	377283	89536	377283	1	1	
CR4.	ZENER CR4, (RESISTORS R1 & R3)						
H1	HEATSINK, INNER, U1	473660	13103	6070B	1		
H2	HEATSINK, OUTER, U1	473678	13103	6071B	1		
H3	HEATSINK, U4	473686	13103	6072B	1		
H4	STRAP, NYLON	172080	06383	SST-1M	1		
H5	SCREW, MACHINE, 4-40 X 3/8	152124	73734	19024	2		
H6	WASHER, LOCK, 4-40	110403	89536	110403	2		
H7	NUT, HEX, 4-40	147611	89536	147611	2		
MP1	INSULATOR	383158	89536	383158	1		
P4	CONNECTOR PINS, MALE	267500	00779	87022-1	15		
P5	CONNECTOR PINS, MALE	267500	00779	87022-1	REF		
P6	CONNECTOR PINS, MALE	267500	00779	87022-1	REF		
R1	RES, SELECTED, SEE CR4	377283	89536	377283	REF		
R2	RES, VAR, 500 +/-10%, 1/2W	291120	89536	291120	1	1	
R3	RES, SELECTED, SEE CR4	377283	89536	377283	REF		
R4	RES, MTL. FILM, 61.9K +/-1%, 1/8W	237230	91637	CMF556192F	1		
S1	SWITCH, PUSH-PUSH, DPDT	291526	89536	291526	1		
U1	IC, LIN, VOLTAGE REGULATOR, +5V DC	355107	12040	F7805UC	2	1	
U2	IC, LIN, VOLTAGE REGULATOR, +15V DC	453035	04713	MC78L15ACP	1	1	
U3	IC, LIN, VOLTAGE REGULATOR, -15V DC	454801	04713	MC79L15ACP	1	1	
U4	IC, LIN, VOLTAGE REGULATOR, +5V DC	355107	12040	F7805UC	REF		
U5	IC, LINEAR, OP AMP	363515	12040	LM301	1	1	

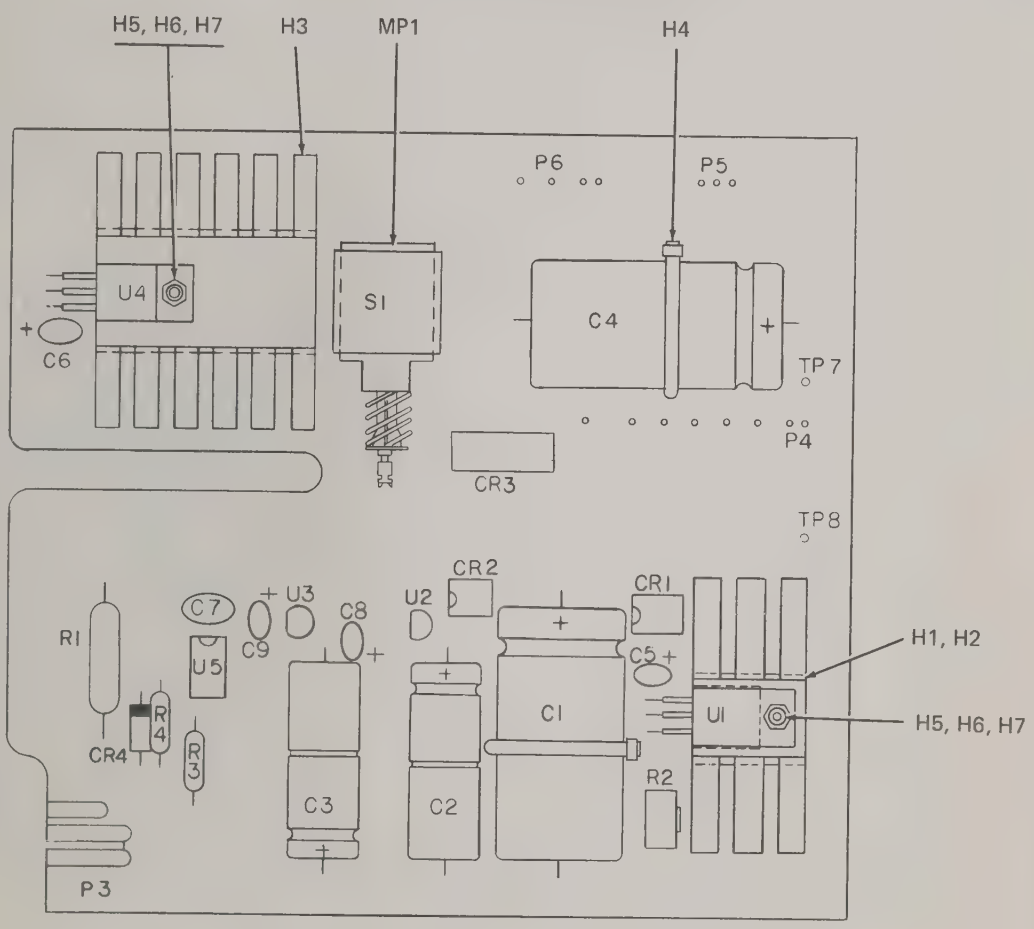

Figure 5-6. Power Supply PCB Assembly

Section 6
Option & Accessory Information

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6-1. INTRODUCTION

6-2. This section of the manual contains information concerning the options and accessories available for use with the Model 2204A Scanner. It consists of a series of subsections that include; introduction, accessories, and options. Each option and accessory is listed by model or option number in the table of contents on page 6-1.

6-3. Accessories include a series of rack mounting kits, remote interface cables/connectors, and scanner extender chassis. The rack mount kits are designed for use in standard 19-inch equipment racks. The cables/connectors are used for I/O connection between the 2204A and the extender chassis.

6-4. Each option for the 2204A is documented as an individual subsection. All of the information necessary for installation, operation, and maintenance is included in a subsection. This includes a list of replaceable parts. Schematics are included in Section 8 of this manual.

6-5. Each subsection is uniquely identified by page and paragraph numbering that relates to the accessories or a particular option. For example, a 600-X series identifies the general accessories subsection and 606-X series identifies the subsection for the -06 Option, where X is a sequential page or paragraph number.

Accessories

600-1. RACK MOUNTING KIT (M07-205-600)

600-2. The scanner can be rack mounted in a standard 19-inch equipment rack using Rack Mounting Kit M07-205-600. Use the following procedure to install the kit.

1. Peel of the name plate decals from the front side-corners of the scanner.

2. Remove the front corner screws which match the hole pattern in the rack mounting ears (see Figure 600-1).

3. Attach the rack mounting ears to the front corners of the unit using the screws supplied in the rack mounting kit.

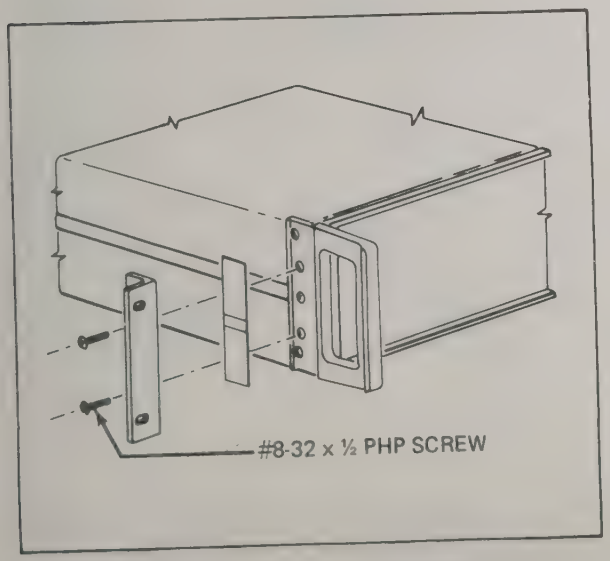

Figure 600-1. Rack Mounting Kit

600-3. RACK SLIDE KIT (M00-280-610)

600-4. The scanner can be rack mounted in a 24-inch deep equipment rack using the Rack Slide Kit, M00-280-610. Use the following procedure to install the kit:

1. Remove the horizontal side trim decal from both sides of the scanner.

2. Refer to Figure 600-2, and, using the screws supplied with the kit, attach the Chassis Section (B) of the slide kit to each side of the unit. Use the center row of mounting holes.

3. Install the Cabinet Section (D) and the Center Section (C) in the equipment rack.

4. Pull the Center Section of the slide out through the front of the equipment rack until it locks in the extended position.

5. Depress the spring locks on the Chassis Section (B) and join Section B and C.

6. Push the instrument into the equipment rack and then pull it out to the extended position. The spring locks should limit the rack slide travel.

600-5. REMOTE SCANNER CABLES

600-6. The cable assemblies necessary to add a series of extender chassis are fabricated by the user on a custom basis. This allows the user to determine the cable lengths necessary for a particular application. The components required to complete a cable are available as two kits; a connector kit 2200A-7001 (two connector assemblies), and a length of cable 2200A-7002. When ordering the cable specify the length in feet. An assembled cable is shown in Figure 600-3.

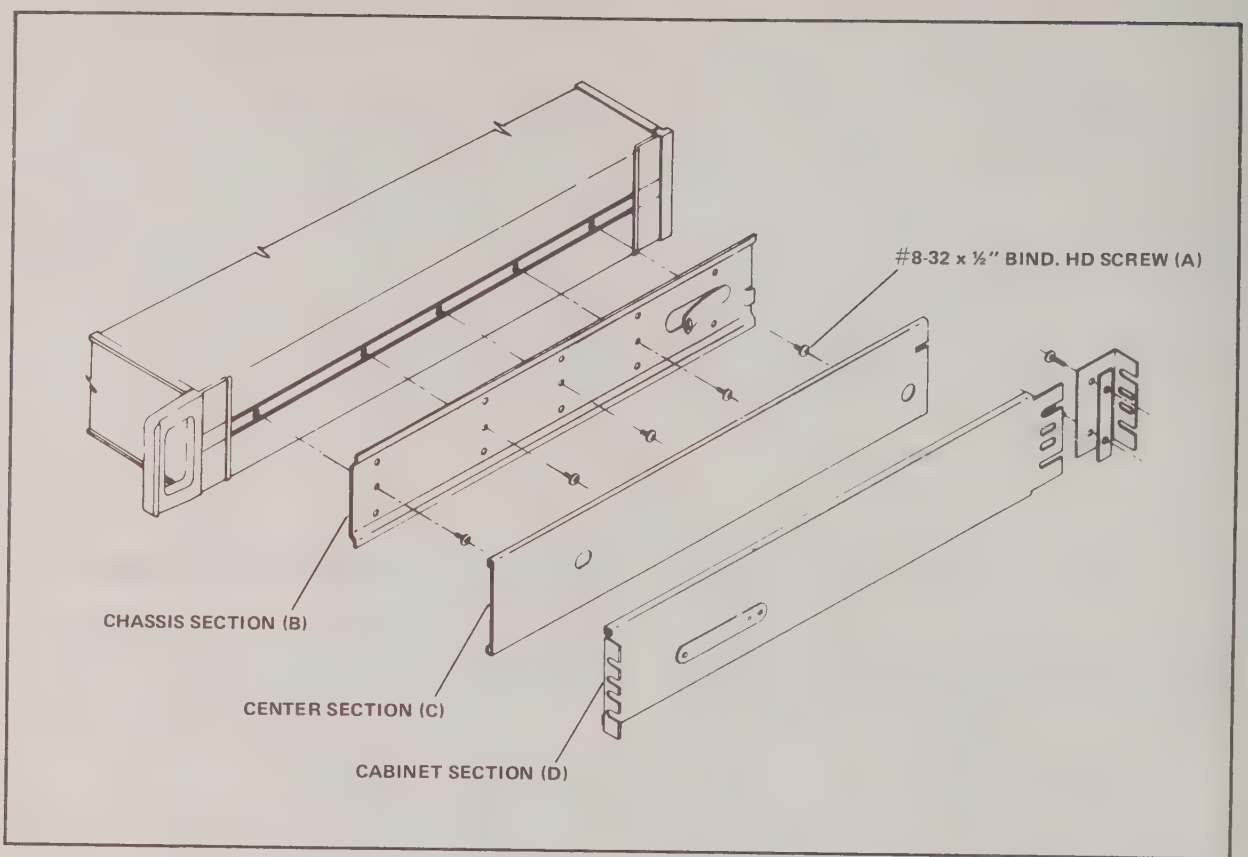

Figure 600-2. Rack Slide Kit

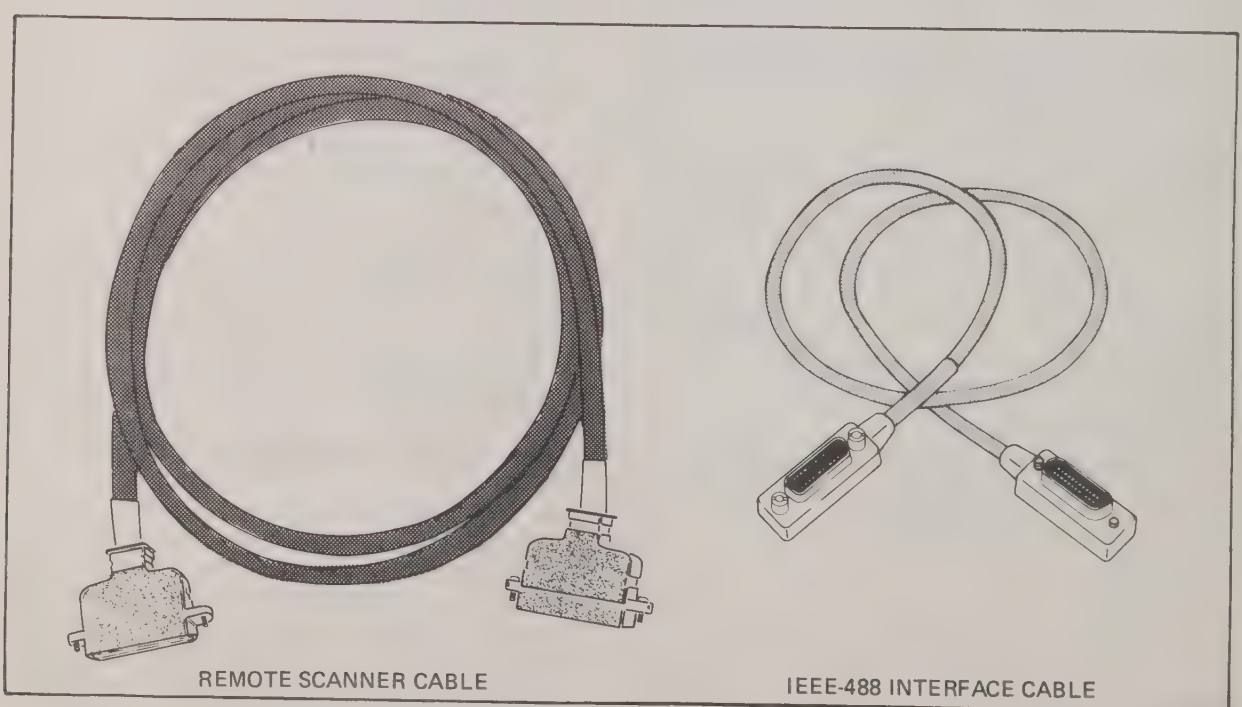

Figure 600-3. Remote Scanner and IEEE-488 Cables

600-7. IEEE-488 INTERFACE CABLES

600-8. A series of three interface cables are available for use with the IEEE-488 Interface (Option -050). The cables are available in 1, 2 and 4 meter lengths (Y8001, Y8002, and Y8003 respectively). As shown in Figure 600-3, the cables are equipped with double-ended connectors so that they may be interconnected in serial and/or star patterns.

600-9. RS-232 INTERFACE CABLE

600-10. A 3-meter interface cable is available for use with the RS-232-C Interface (Option -060). Specify Model Y8004 when ordering.

600-11. DELAY TRIGGER CABLE

600-12. A 0.9 meter coax cable with male BNC connectors is available for use as a 2204A trigger delay cable. Specify Model Y8013 when ordering.

600-13. EXTENDER CHASSIS 2201A/2202A

600-14. The channel capacity of the 2204A can be expanded from 100 up to 1000 by adding a series of extender chassis. Two units are available for this purpose; the Model 2201A (120 channels) and the Model 2202A (100 channels). Both units function as a physical extension of the 2204A. The scanners are under the direct control of the 2204A logic. The Model 2201A is recommended for applications not more than 50 feet away from the 2204A. Locations from 51 to 1500 feet from the 2204A should use the 2202A.

Option -06
Low Level Scanner

606-1. INTRODUCTION

606-2. The Low Level Scanner (Option 2200A-06) is a plug-in, 10-channel, 3-wire relay scanner designed to operate as a low-level, analog data multiplexer in a 2204A Scanner. Switched high, low and shield inputs are provided for each of the 10 channels. A decoupling relay is used to isolate the high, low and shield buses from the common output connections when a channel relay is not activated. Activating any one of the 10-channel relays also energizes the decoupling relay.

606-3. SPECIFICATIONS

606-4. Specifications for the Low Level Scanner are contained in Section 1 of this manual.

606-5. INSTALLATION

606-6. The Low Level Scanner mounts in any one of the available scanner block slots provided in the 2204A, as shown in Figure 606-1. Install the scanner as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE SCANNER BEFORE STARTING THIS PROCEDURE.

1. Remove the top dust cover from the 2204A.

2. Remove the top-inner cover located toward the rear of the unit (as viewed from the top front).

CAUTION

Handle the scanner pcb by its edges to avoid contaminating the pcb with oil from the hands. The use of gloves is recommended.

3. Select the slot that includes the block of channels the scanner is to represent, and align the scanner in the slot so that the 44-pin board-edge connector is toward the rear of the unit, and the small offset board-edge connectors are toward the bottom of the unit. Push the scanner straight down onto the mating connectors.

4. After the desired number of scanners are installed, install the inner cover.

5. Install the top dust cover.

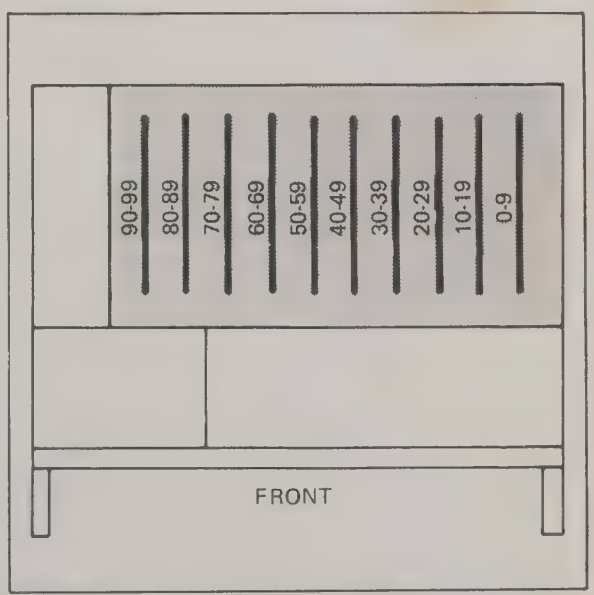

Figure 606-1. Scanner Mounting Locations

606-7. OPERATION

606-8. Once installed in the 2204A, the Low Level Scanner requires no operator attention. However,

certain considerations are necessary to properly interface the scanner with analog input data. These considerations are covered in the following paragraphs.

606-9. Input Connections

606-10. Analog interface connections with the Low Level Scanner are completed through either one-of-two types of connectors, both of which are available as options. They include the Solder Pin Connector (Option 2200A-07) and the Isothermal Block Connector (Option 2200A-08). The Solder Pin Connector is a general purpose assembly which consists of a 44-pin connector mounted on a pcb. Solder type cable connections are provided. A clam-shell housing provides strain relief for the cable, and protection of the connector contacts. The Isothermal Block Connector is required for thermocouple inputs. It features an isothermal block with screw-type connections, and a temperture sensing circuit. Refer to the appropriate option subsection for additional information.

606-11. Input Pin Assignments

606-12. The pin assignments for the rear panel connector of the Low Level Scanner are shown in Figure 606-2. Since contact with these signals is completed through one-of-two optional connectors (Option -07 or -08) refer to the appropriate option subsection for pin assignments as available for fabricating interface cables.

NOTE

The Guard connections shown in Figure 606-2 represent a unique potential within the 2204A. Input shields should be connected to the Shield pins, not to the Guard pins.

606-13. THEORY OF OPERATION

606-14. The Low Level Scanner, as shown in Figure 606-3, is a programmable, 10-channel relay scanner designed to operate as a plug-in option in any one of the scanner block slots in a 2204A Scanner. Channel scanning or multiplexing is accomplished by a series of 11 three-pole, form-A, reed relays. Ten of the relays serve as three-wire input channel switches to a common (high/low/shield) output bus. The eleventh relay also contacts the three-wire bus. However, its function is to isolate or decouple the scanner bus from the actual output connections. When any one of the channel relays is energized the decoupling relay is also activated to complete the three-wire input/output circuit.

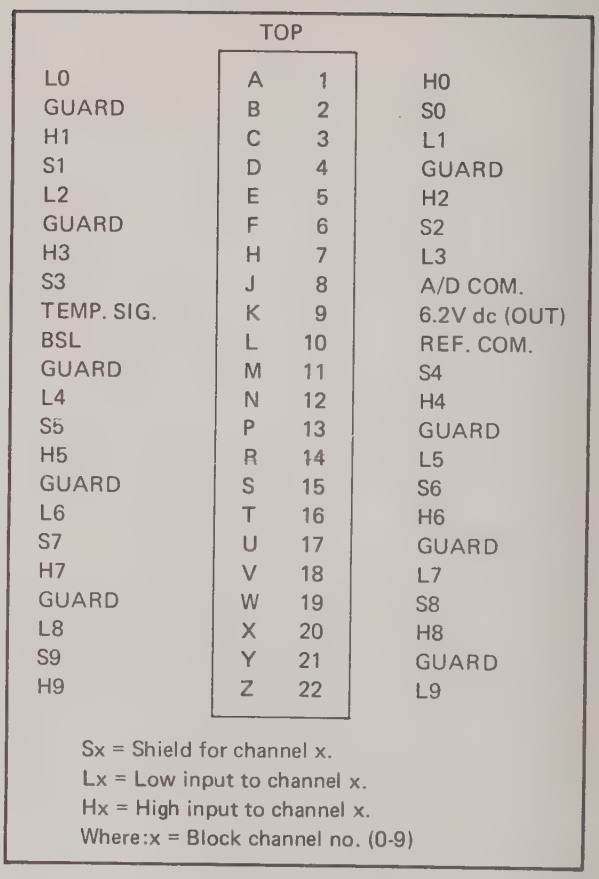

Figure 606-2. Analog Connector Pin Assignments

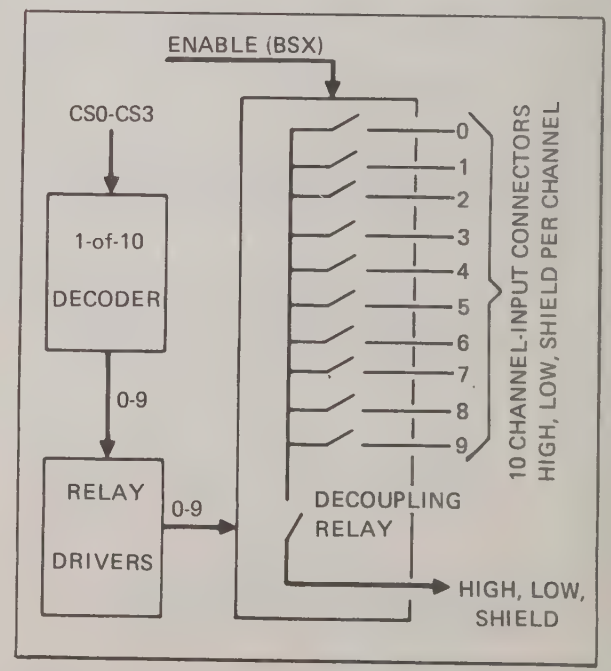

Figure 606-3. Low Level Scanner Functional Block Diagram

606-15. All scanner pcb's installed in the 2204A and/or extender chassis receive bcd channel select information in parallel from a 4-bit data bus (CS0 through CS3). This data is decoded on each scanner pcb into 10 separate channel commands (0-9). Each command line is first buffered and then connected to one of the 10-channel-relay coils. Even though these commands are present, the relays will not be energized unless the scanner receives a scanner-block select (BSX) command. This command is actually an address or enable signal which applies a control command to the low side of the relay coils. When this signal is present the decoupling relay and the selected channel relay will be energized. At that time the analog input data on the selected channel appears at the scanner output terminals.

606-16. MAINTENANCE

606-17. Access Information

606-18. Refer to the installation information given earlier for scanner access information. Remove the rear panel input connector before attempting to remove the scanner pcb from its slot.

606-19. Performance Test

606-20. The performance test is designed to verify the overall operation of the Low Level Scanner PCB Assembly, and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 606-1. If the scanner fails any part of the performance test, corrective action is required.

1. Using the resistors and the input connector specified in Table 606-1, fabricate a scanner test cable as shown in Figure 606-4.

2. Install the Low Level Scanner PCB in the channel 0-9 slot of the 2204A.

3. Set the calibrator output to 0V dc.

4. Connect the test cable leads to the calibrator's voltage output terminals (red to positive, black and white to negative).

5. Set the calibrator output to 1.000V dc.

6. Manually program the 2204A as follows:

   a. First channel to 0.

   b. Last channel to 9.

7. Manually scan channels 0 through 9. Channel 0 should read +1.000V dc ±1%. A cumulative +0.1V dc decrease should be observed at each of the remaining channels (Channel 9 should read +0.1V dc.) Any deviation in this pattern indicates a defective pcb assembly.

Table 606-1. Required Test Equipment

INSTRUMENT	RECOMMENDED MODEL
DC Voltage Calibrator	Fluke 343A
Scanner	Fluke 2204A
Input Connector	Fluke 2200A-07 or -08
Resistors (10 each)	Metal film, 1k ±1%, ¼W

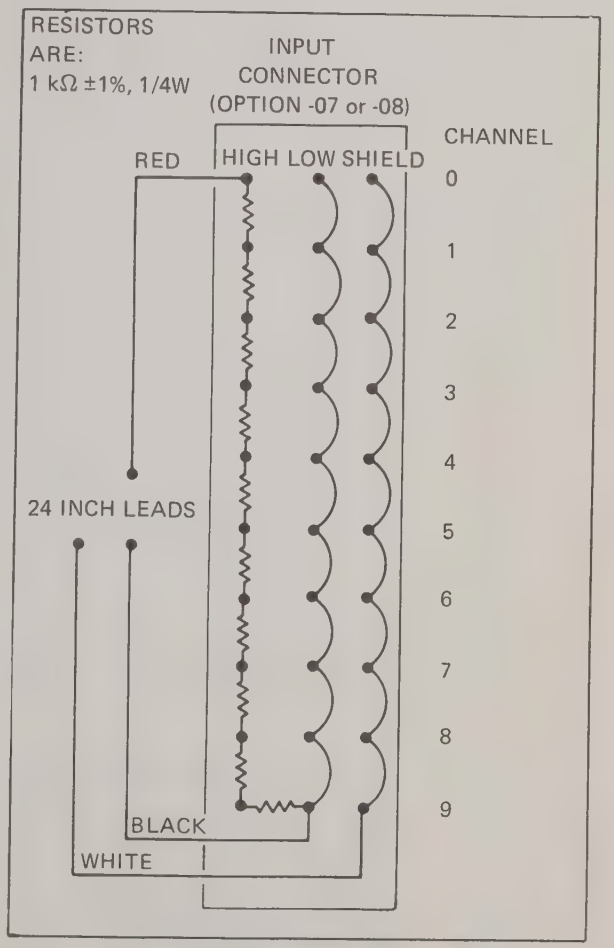

Figure 606-4. Scanner Test Cable

606-21. LIST OF REPLACEABLE PARTS

606-22. A list of replaceable parts for the Low Level Scanner PCB Assembly is given in Table 606-2. Refer to Section 5 of this manual for ordering information.

⊗ CAUTION

Indicated devices are subject to damage by static discharge.

Table 606-2. Low Level Scanner PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-06	LOW LEVEL SCANNER PCB ASSY, OPTION -06 (2200A-4029T) FIGURE 606-5						
CR0	DIODE, SI SWITCH	203323	07910	1N4448	11	3	
CR1	DIODE, SI SWITCH	203323	07910	1N4448	REF		
CR2	DIODE, SI SWITCH	203323	07910	1N4448	REF		
CR4	DIODE, SI SWITCH	203323	07910	1N4448	REF		
CR5	DIODE, SI SWITCH	203323	07910	1N4448	REF		
CR6	DIODE, SI SWITCH	203323	07910	1N4448	REF		
CR7	DIODE, SI SWITCH	203323	07910	1N4448	REF		
CR8	DIODE, SI SWITCH	203323	07910	1N4448	REF		
CR9	DIODE, SI SWITCH	203323	07910	1N4448	REF		
CR10	DIODE, SI SWITCH	203323	07910	1N4448	REF		
J14	CONNECTOR, MALE, 12-PIN	380683	27264	A2402-09-64-1121	1		
K0	RELAY ASSEMBLY						
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	11		
	CORE, METAL, RELAY-COIL	380451	89536	380451	11		
K1	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K2	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K3	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K4	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K5	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K6	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K7	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K8	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K9	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
K10	RELAY ASSEMBLY				REF		
	COIL, REED RELAY, 135 +/-10%, 5V/DC	380709	71707	E8206	REF		
	CORE, METAL, RELAY-COIL	380451	89536	380451	REF		
MP1	SHIELD, BOTTOM	412296	89536	412296	1		
MP2	SHIELD, TOP	412304	89536	412304	1		
MP3	SPACER, SHIELD, BOTTOM	412320	89536	412320	1		
MP4	SPACER, SHIELD, TOP	412312	89536	412312	1		

Table 606-2. Low Level Scanner PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
P14	CONNECTOR, FEMALE, 12-PIN	380691	27264	2145B09-52-3122	1		
Q0	XSTR, SI, PNP	195974	04713	2N3906	10	2	
Q1	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q2	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q3	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q4	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q5	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q6	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q7	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q8	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q9	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q10	XSTR, SI NPN	218396	04713	2N3904	1	1	
Q11	XSTR, SI, NPN	182196	07263	2N3643	1	1	
Q12	XSTR, FET, N-CHANNEL	357905	89536	357905	1	1	
R0	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	31		
R1	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R2	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R3	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R4	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R5	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R6	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R7	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R8	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R9	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R10	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R11	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R12	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R13	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R14	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R15	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R16	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R17	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R18	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R19	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R20	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R21	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R22	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R23	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R24	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R25	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R26	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R27	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R28	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R29	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R33	RES, COMP, 10K +/-5%, 1/2W	109165	01121	EB1035	1		
R34	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
S0	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	33		
S1	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S2	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S3	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		

Table 606-2. Low Level Scanner PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
S4	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S5	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S6	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S7	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S8	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S9	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S10	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S11	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S12	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S13	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S14	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S15	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S16	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S17	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S18	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S19	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S20	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S21	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S22	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S23	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S24	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S25	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S26	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S27	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S28	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S29	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S30	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S31	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
S32	SWITCH, DRY REED, SPST, 3W, 40V	380717	95348	MR-0780-3	REF		
U1	IC, C-MOS, 1-OF-10 DECODER	407981	12040	MM74C42			
XQ11	SPACER, XSTR MOUNTING	152207	07047	10123-DAP	1		
XU1	SOCKET, IC, 16-PIN	276535	91506	316AG39D	1		

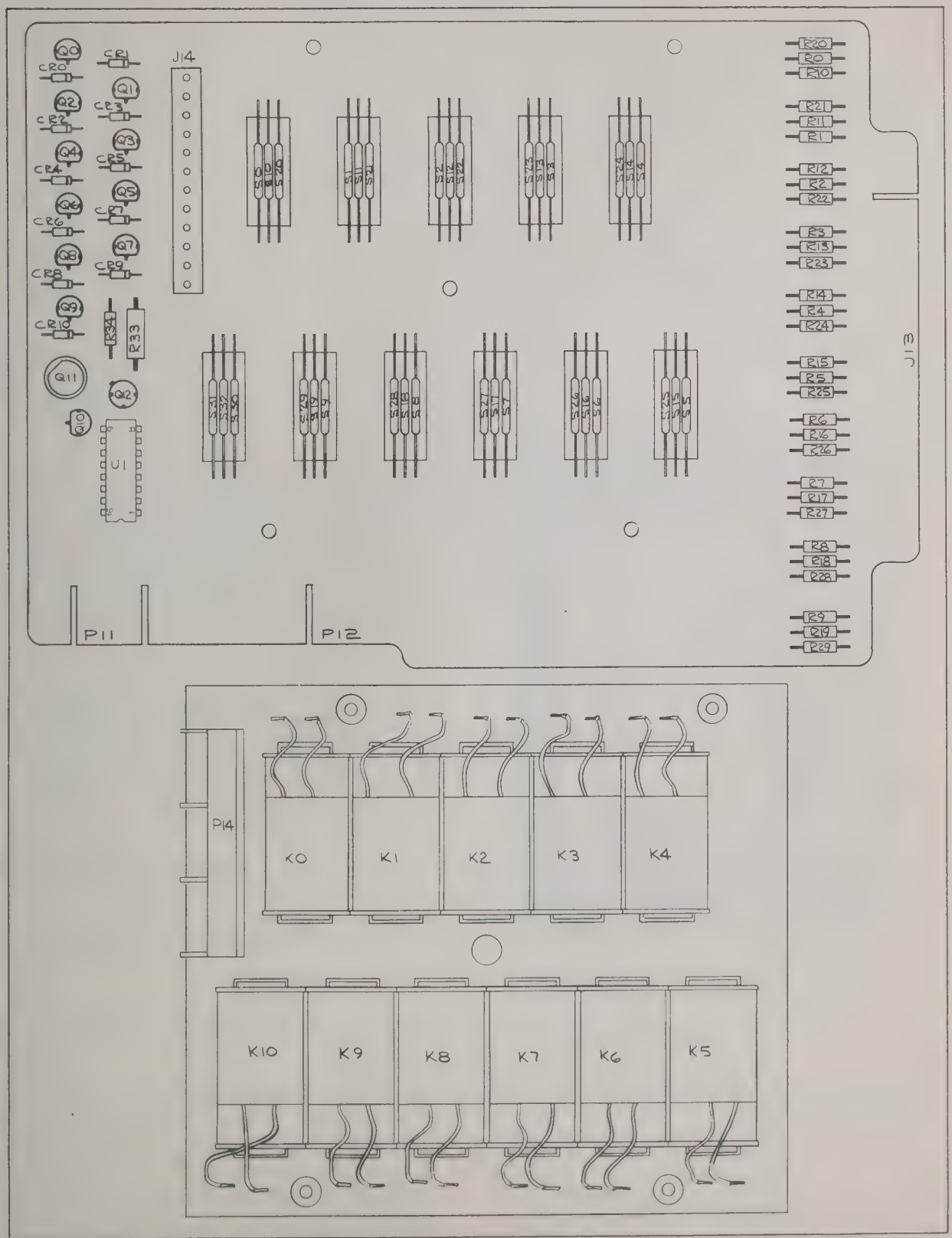

Figure 606-5. Low Level Scanner PCB Assembly

Option -07
Solder Pin Connector

607-1. INTRODUCTION

607-2. The Solder Pin Connection (Option -07) is a general purpose connector assembly which mounts in the rear the 2204A and provides electrical contact with the analog inputs of either the General Purpose Scanner or the Low Level Scanner. The connector is designed for use in fabricating a custom interface cable to provide external analog inputs to a single relay scanner (10 analog channels).

607-3. The connector assembly consists of a 44-pin board-edge connector which is mounted on a pcb housed in a clam-shell enclosure. The enclosure separates from the assembly to provide access to solder-type connections at the rear of the connector. Strain relief for the cable connection is provided by the enclosure.

607-4. SPECIFICATIONS

607-5. Specifications for the Solder Pin Connector are contained in Section 1 of this manual.

607-6. CABLE FABRICATION

607-7. Figure 607-1 identifies the connector pins and signals necessary to interface external analog input data with either the General Purpose Scanner or the Low Level Scanner. Access to the solder-type terminals on the connector is accomplished by removing the four screws from the decal side of the connector enclosure. The decal identifies the pin connections and provides spaces for the user to uniquely identify the connector's block assignment and each of its channel inputs.

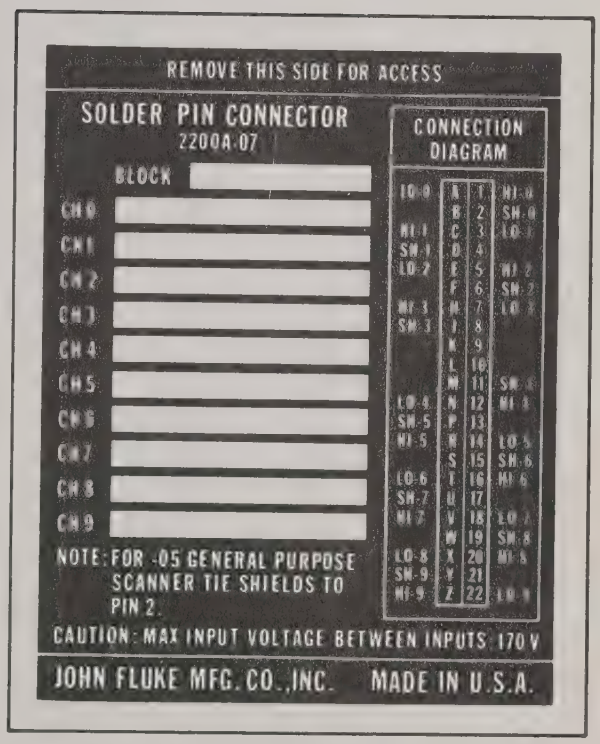

Figure 607-1. Solder Pin Connector Pin Assignments

607-8. INSTALLATION

607-9. The Solder Pin Connector and cable assembly mounts in any one of the available scanner-block slots containing a scanner module. See Figure 607-2. Install the Solder Pin Connector as follows:

1. Unlatch the two slide fasteners located on either side of the protruding enclosure on the rear of the 2204A. Remove the enclosure from the rear panel.

2. Locate the desired scanner-block slot on the rear panel and check to ensure that a scanner module is installed in the slot.

3. With the connector key toward the top, position the Solder Pin Connector in the guides of the selected scanner block and mate it with the scanner's connector.

4. Install the retaining screws and washers that hold the input connector to the 2204A.

5. After the required number of input connectors are installed, install the rear-panel enclosure.

607-10. LIST OF REPLACEABLE PARTS

607-11. A list replaceable parts for the Solder Pin Connector Assembly is given in Table 607-1. Refer to Section 5 of this manual for ordering information.

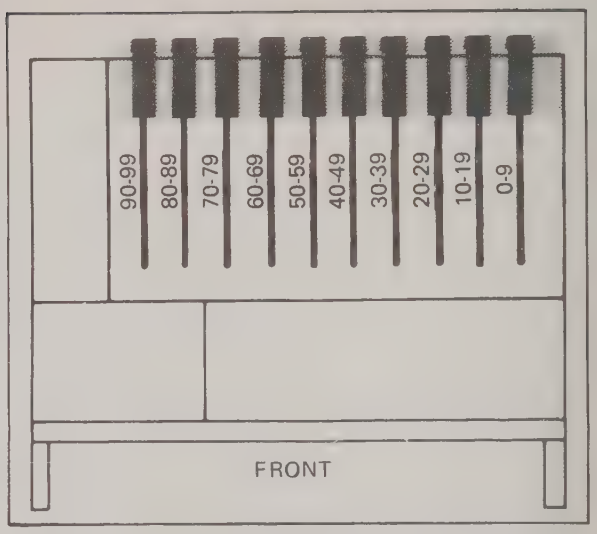

Figure 607-2. Solder Pin Connector Mounting Locations

Table 607-1. Solder Pin Connector Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-07	SOLDER PIN CONNECTOR ASSY (2200A-07) FIGURE 607-3						
	CONNECTOR BOARD ASSEMBLY						
H1	CONNECTOR PCB	373332	89536	373332	1		
H2	CONNECTOR, BOARD-EDGE, 44-PIN	385666	13511	225-22221-101	1		
H3	KEY, CONNECTOR, POLARIZING	407254	13511	225-22221-101-22	1		
MP1	HOUSING, HOUSING, PLASTIC	414276	89536	414276	2		

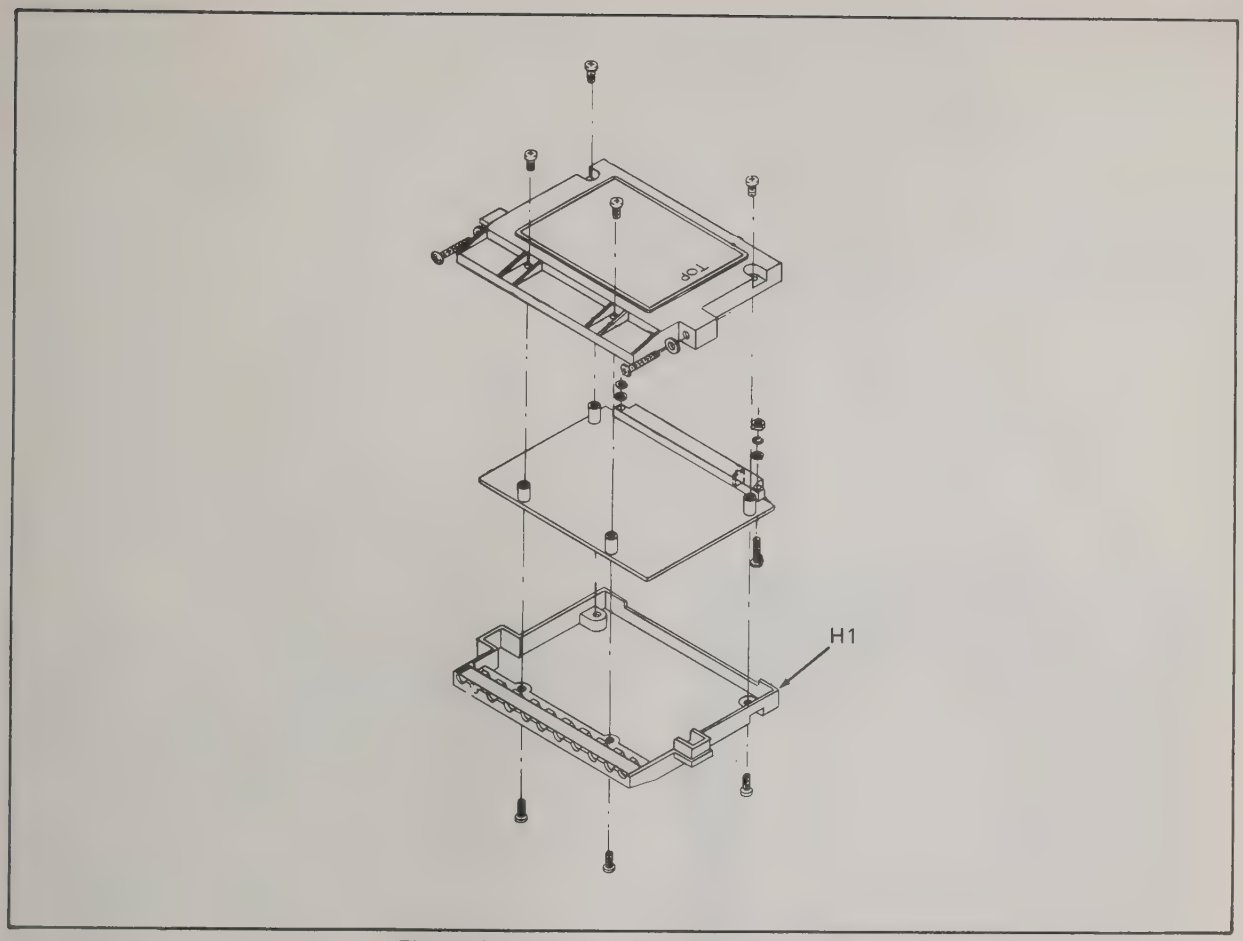

Figure 607-3. Solder Pin Connector Assembly

Option -08
Isothermal Block Connector

608-1. INTRODUCTION

608-2. The Isothermal Block Connector (Option 2200A-08) is a 44-pin card-edge connector assembly designed for inputting low level thermocouple voltages and/or general purpose dc voltages to either the General Purpose Scanner (Option 2200A-310) or the Low Level Scanner (Option 2200A-06). Convenient screw-type input terminals are used to provide a fast and reliable method of completing the input connections. These terminals are thermally integrated into an isothermal block which is allowed to drift with ambient temperature. A temperature measuring circuit monitors the block temperature, and returns a proportional voltage to the 2204A. This voltage is used by a remote controller to calculate the temperature represented by each of up to 10 thermocouple generated input voltages (i.e., one per channel). The temperature measuring feature does not interfere with ordinary voltage measurements.

608-3. SPECIFICATIONS

608-4. Specifications for the Isothermal Block Connector are given in Section 1 of this manual.

608-5. INPUT CONNECTIONS

608-6. Figure 608-1 identifies the location of the high, low and shield inputs terminals for each of the 10 scanner channels. Access to the terminals is accomplished be removing the four screws from the decal-side of the connector enclosure. As input connections are completed use the spaces provided on the connector decal to uniquely identify the connector's block (slot) assignment and each of its channel input signals.

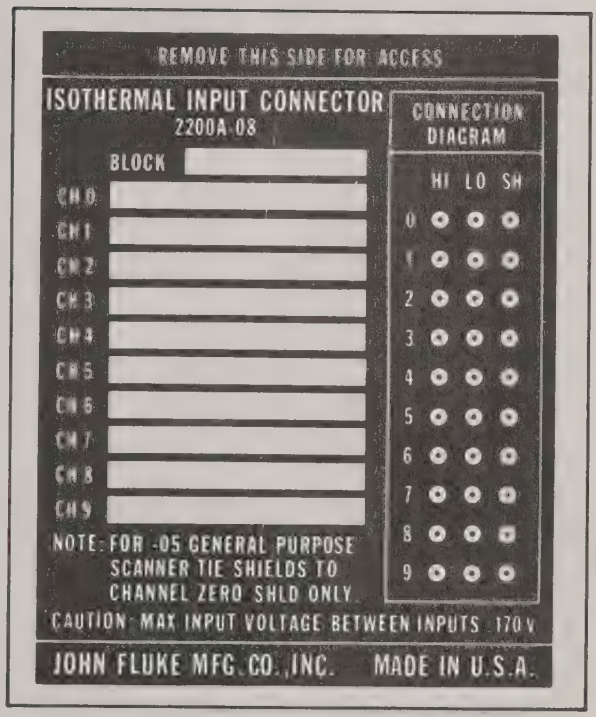

Figure 608-1. Connector Terminal Assignments

608-7. INSTALLATION

608-8. The Isothermal Block Connector can be mounted in any one of the 2204A scanner-block slots which contain a relay scanner (Option -050 or -060). See Figure 608-2. Install the connector as follows:

1. Unlatch the slide fasteners located on either side of the protruding enclosure at the rear of the 2204A. Remove the enclosure from the rear panel.

2. Locate the desired scanner-block slot on the rear panel and check to ensure that a scanner module is installed in the slot.

3. With the connector key toward the top, position the Isothermal Block Connector in the guides of the selected slot and mate it with the scanner's connector.

4. Install the retaining screws and washers that hold the input connector to the 2204A.

5. After the required number of input connectors are installed, install the rear-panel enclosure.

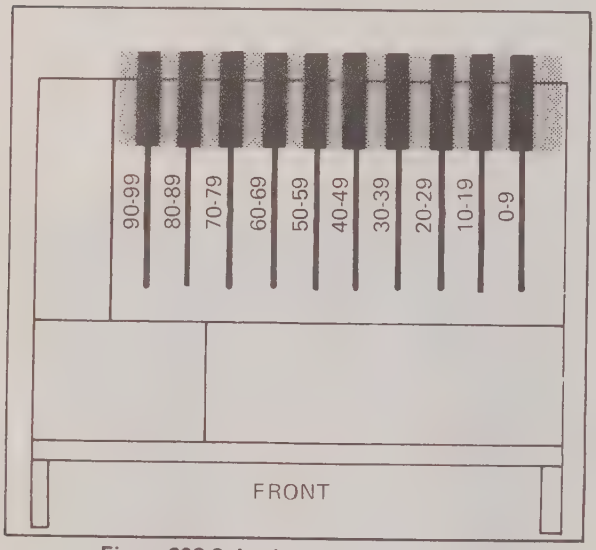

Figure 608-2. Isothermal Block Connector Mounting Locations

608-9. OPERATION

608-10. Once installed, the Isothermal Block Connector requires no operator attention.

608-11. THEORY OF OPERATION

608-12. The Isothermal Block Connector provides the connections necessary for supplying voltage and/or (thermocouple) temperature inputs to any 10 scanner channels. Input connections are in the form of 10 sets of 3-screw terminals (high, low, and guard). The input signals at any given channel are measured in terms of voltage. When thermocouple inputs are used, temperature is calculated using both the thermocuple voltage and the reference voltage.

608-13. When the temperature function is programmed, it is assumed that a thermocouple probe is providing the input signal to that channel. Under these conditions the Isothermal Block Connector provides the remote measurement device with the information necessary to compute the actual temperature at the thermocouple probe. This information includes the thermocouple voltage at the input terminals and a voltage indicative of the thermocouple input terminal temperature. The thermocouple input voltage is a direct result of the probe temperature versus the input terminal temperature. The input terminal temperature is measured by a separate sensing circuit and is electrically isolated from the thermocouple connections.

608-14. The temperature sensing circuit consists of forward biased semiconductor junction which is thermally integrated into an anodized aluminum block. This block also surrounds and thermally integrates each of the 30 screw-type input terminals The mass and temperature response of the block is such that the input terminal temperature and the semiconductor sensor are held to within less than $\pm 0.05°C$ of each other. Actual block temperature is allowed to vary with ambient temperature.

608-15. When a relay scanner is addressed, the temperature sensing circuit provides the remote measurement device with a voltage input proportional to the temperature of the isothermal block. This method of compensating a thermocouple reference junction is accurate over a temperature range of 0 to 50°C.

608-16. CALIBRATION

608-17. The temperature sensor on the Isothermal Block Connector has been calibrated at the factory and does not require periodic calibration to meet the specifications given in Section 1.

608-18. LIST OF REPLACEABLE PARTS

608-19. A list of replaceable parts for the Isothermal Block Connector is given in Table 608-1. Refer to Section 5 of this manual for ordering information.

Table 608-1. Isothermal Block Connector Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-08	ISOTHERMAL BLOCK CONNECTOR ASSY, OPT.-08 FIGURE 608-3						
C1	CAP, CER 0.05 UF +/-20%, 50V	149161	56289	55C23A1	1		
H1	KEY, CONNECTOR, POLARIZING	407254	13511	225-22221-105-22	1		
MP1	INSULATOR, ISOTHERMAL BLOCK	373340	89536	373340	1		
MP2	ISOTHERMAL BLOCK	412379	89536	412379	1		
P13	CONNECTOR, BOARD-EDGE, 44-PIN	385674	13511	225-22221-105	1		
Q1	XSTR, SI, PNP (SELECTED)	380394	89536	380394	1	1	
Q2	XSTR, FET, N-CHANNEL	357905	89536	357905	1	1	
R1	RES, COMP, 330K +/-5%, 1/4W	192948	01121	EB3345	1		
R2	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	EB4725	1		
R3	RES, MF, 130K +/-1%, 1/8W	221648	91637	MFF1-81303F	1		
R4	RES, FACTORY SELECTED (76.8K, 100K, 147K, 287K OR OPEN)						
R5	RES, VAR, CERMET, 150K +/-10%	414102	11236	360T151A	1	1	

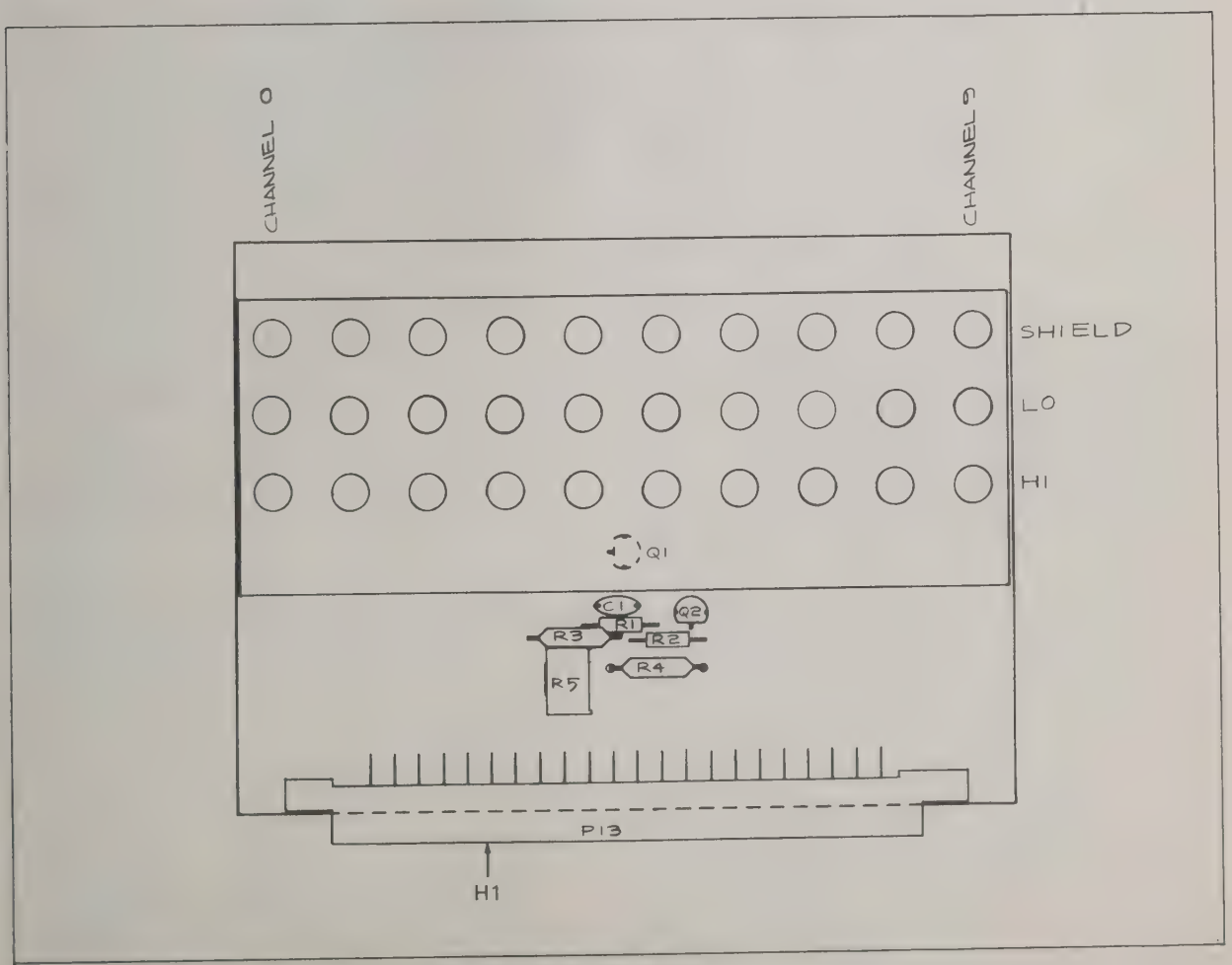

Figure 608-3. Isothermal Block Connector Assembly

Option -310
General Purpose Scanner

610-1. INTRODUCTION

610-2. The General Purpose Scanner (Option 2200A-310) is a plug-in, 10-channel, 2-wire relay scanner designed to operate as a general purpose, analog data multiplexer in a 2204A Scanner. Switched high and low inputs are provided for each of the 10 channels and a low common (unswitched) shield is provided for all 10 channels. A decoupling relay is used to isolate the high, low, and shield buses from the common output connections when a channel relay is not activated. Activating any one of the 10 channel relays also energizes the decoupling relay.

610-3. SPECIFICATIONS

610-4. Specifications for the General Purpose Scanner are given in Section 1 of the manual.

610-5. INSTALLATION

610-6. The General Purpose Scanner mounts in any one of the available scanner-block slots provided in the 2204A, as shown in Figure 610-1. Install the scanner as follows:

WARNING

REMOVE LINE-POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE 2204A BEFORE STARTING THIS PROCEDURE.

1. Remove the top dust cover for the 2204A.

2. Remove the top-inner cover located toward the rear of the unit (as viewed from the top front).

CAUTION

Handle the scanner pcb by its edges to avoid contaminating the pcb with oil from the hands. The use of gloves is recommended.

3. Select the slot that includes the block of channels the scanner is to represent, and align the scanner in the slot so that the large board-edge connector is toward the rear of the unit, and the small offset board-edge connectors are toward the bottom of the unit. Push the scanner straight down onto the mating connectors.

4. After the desired number of scanners are installed, install the inner cover.

5. Install the top dust cover.

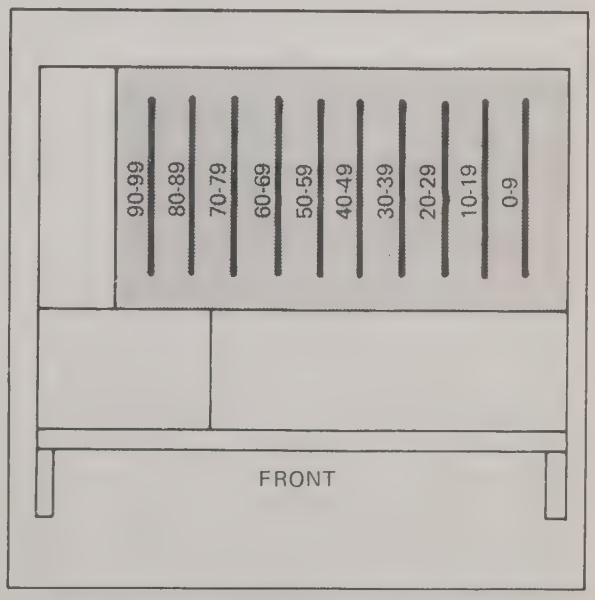

Figure 610-1. Scanner Mounting Locations

610-7. OPERATION

610-8. Once installed in the 2204A, the General Purpose Scanner requires no operator attention.

However, certain considerations are necessary to properly interface the scanner with analog input data. These considerations are covered in the following paragraphs.

610-9. Input Connections

610-10. Analog interface connections with the General Purpose Scanner are completed through either one-of-two types of connectors, both of which are available as options. They include the Solder Pin Connector (Option 2200A-07) and the Isothermal Block Connector (Option 2200A-08). The Solder Pin Connector is a general purpose assembly which consists of a 44-pin connector with solder-type cable connections. A clam-shell housing provides strain relief for the cable, and protection of the connector contacts. The Isothermal Block Connector is required for the thermocouple inputs. It features an Isothermal block with screw-type connections, and a temperature sensing circuit. Refer to the appropriate option subsection for additional information.

610-11. Input Pin Assignments

610-12. The pin assignments for the rear-panel connector of the General Purpose Scanner are shown in Figure 610-2. Since contact with these signals is completed through one-of-two connector assemblies (Option 2200A-07 or -08) refer to the appropriate option subsection for pin assignments as available for fabricating interface cables.

NOTE

The Guard connections shown in Figure 610-2 represent a unique potential within the 2204A. Input shields should be connected to the Shield (pin 2), not the Guards.

TOP

L0	A	1	H0
GUARD	B	2	SHIELD
H1	C	3	L1
–	D	4	GUARD
L2	E	5	H2
GUARD	F	6	–
H3	H	7	L3
–	J	8	A/D COM.
TEMP. SIG.	K	9	6.2V dc (OUT)
BSL	L	10	REF. COM.
GUARD	M	11	–
L4	N	12	H4
–	P	13	GUARD
H5	R	14	L5
GUARD	S	15	–
L6	T	16	H6
–	U	17	GUARD
H7	V	18	L7
GUARD	W	19	–
L8	X	20	H8
–	Y	21	GUARD
H9	Z	22	L9

Lx = Low input to channel x.
Hx = High input to channel x.
Where: x = Block channel No. (0 - 9)
– = Not Used

Figure 610-2. Analog Connector Pin Assignments

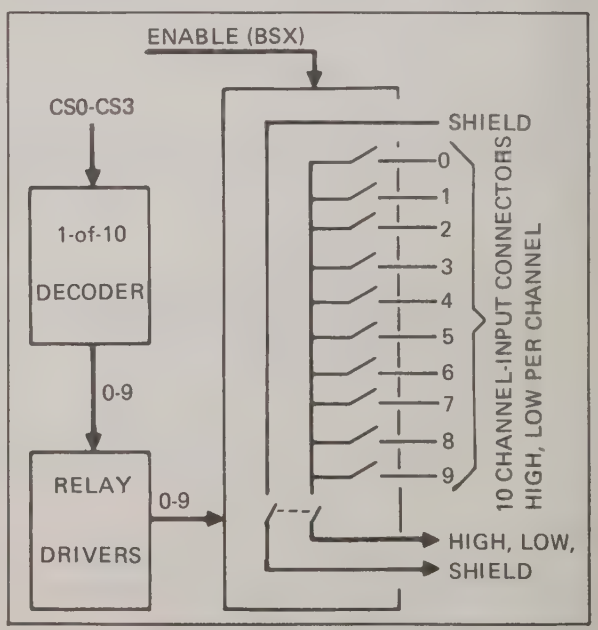

Figure 610-3. General Purpose Scanner Functional Block Diagram

610-13. THEORY OF OPERATION

610-14. The General Purpose Scanner, as shown in Figure 610-3, is a programmable, 10-channel relay scanner designed to operate as a plug-in option in any one of the scanner-block slots in a 2204A Scanner. Channel scanning or multiplexing is accomplished by a series of 12 form-A reed relays, 11 double-pole and 1 single-pole. Ten of the double-pole relays serve as two-wire input channel switches to a common high/low output bus. The eleventh two-pole relay also contacts the two-wire bus. However, its function is to isolate or decouple the scanner bus from the actual output connections. When any one of the channel relays is energized the decoupling relay is also activated to complete the two-wire input/output circuit. The single-pole relay operates in parallel with the decoupling relay. When closed, it connects a common channel-input shield to the output shield connection. Thus, the scanner actually provides a three-wire output (high, low and shield).

610-15. All scanner pcb's installed in a 2204A receive bcd channel select information from a single data bus (CS0 through CS3). This data is decoded on each scanner pcb into 10 separate channel commands (0-9). Each channel line is first buffered and then connected to one of the 10 channel relay coils. Even though these commands are present the relays will not be energized unless the scanner receives a scanner-block select (BSX) command. This command is actually an address or enable signal which applies voltage to the low side of the relay's coils. When the coil voltage is present the decoupling relay, the shield relay and the selected channel relay will be energized. At that time the analog input data on the selected channel appears at the scanner output terminals.

610-16. MAINTENANCE

610-17. Access Information

610-18. Refer to the installation information given earlier for scanner access information. Remove the rear panel input connector before attempting to remove the scanner pcb from its slot.

610-19. Performance Test

610-20. The performance test is designed to verify the overall operation of the General Purpose Scanner PCB Assembly and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 610-1. If the scanner fails any part of the performance test, corrective action is required.

1. Using the resistors and the input connector specified in Table 610-1, fabricate a scanner test cable as shown in Figure 610-4.

2. Install the Low Level Scanner PCB in the channel 0-9 slot of the 2204A.

3. Set the calibrator output to 0V dc.

4. Connect the test cable leads to the calibrator's voltage output terminals (red to positive, black and white to negative).

5. Set the calibrator output to 1.000V dc.

6. Manually program the 2204A as follows:

   a. First channel to 0.

   b. Last channel to 9.

7. Manually scan channels 0 through 9. Channel 0 should read +1.000V dc ±1%. A cumulative +0.1V dc decrease should be observed at each of the remaining channels. (Channel 0 should read +0.1V dc.) Any deviation in this pattern indicates a defective pcb assembly.

Table 610-1. Required Test Equipment

INSTRUMENT	RECOMMENDED MODEL
DC Voltage Calibrator	Fluke 343A
Scanner	Fluke 2204A
Input Connector	Fluke 2200A-07 or -08
Resistors (10 each)	Metal film, 1k ±1%, ¼W

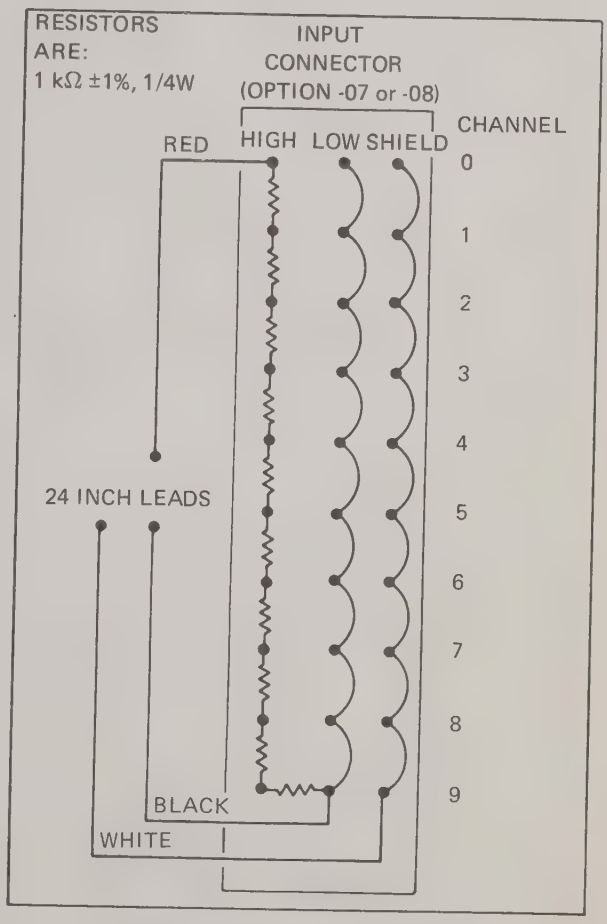

Figure 610-4. Scanner Test Cable

610-21. LIST OF REPLACEABLE PARTS

610-22. A list of replaceable parts for the General Purpose Scanner PCB Assembly is given in Table 610-2. Refer to Section 5 of this manual for ordering information.

⊗ CAUTION

Indicated devices are subject to damage by static discharge.

Table 610-2. General Purpose Scanner PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-310	GENERAL PURPOSE SCANNER PCB ASSY, OPT.-310, (2200A-4037T) FIGURE 610-5						
CR0	DIODE, SI	203323	07910	1N4448	11	2	
CR1	DIODE, SI	203323	07910	1N4448	REF		
CR2	DIODE, SI	203323	07910	1N4448	REF		
CR3	DIODE, SI	203323	07910	1N4448	REF		
CR4	DIODE, SI	203323	07910	1N4448	REF		
CR5	DIODE, SI	203323	07910	1N4448	REF		
CR6	DIODE, SI	203323	07910	1N4448	REF		
CR7	DIODE, SI	203323	07910	1N4448	REF		
CR8	DIODE, SI	203323	07910	1N4448	REF		
CR9	DIODE, SI	203323	07910	1N4448	REF		
CR10	DIODE, SI	203323	07910	1N4448	REF		
H1	SPACER, TRANSIPAD	152207	07047	10123-DAP	1		
K0	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	11		
K1	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K2	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K3	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K4	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K5	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K6	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K7	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K8	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K9	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K10	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K11	RELAY, DRY REED, SPST						
	COIL	269019	71707	U-6-P	1		
	SWITCH, REED	414300	95348	MR5830-7	1		
MP1	COVER, SCANNER, PROTECTIVE	371542	89536	371542	1		
MP2	DECAL, PART NO.	475517	89536	475517	1		
Q0	XSTR, SI, PNP	195974	04713	2N3906	10	2	
Q1	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q2	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q3	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q4	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q5	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q6	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q7	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q8	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q9	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q10	XSTR, J-FET, N-CHANNEL	352112	07910	U26106	1	1	
Q12	XSTR, SI, NPN	182196	07263	2N3643	1	1	
Q13	XSTR, SI, NPN	218396	04713	2N3904	1	1	
R1	RES, MF, 40.2 +/-1%, 1/8W	484014	91637	CMF5540R2F	3		
R2	RES, MF, 40.2 +/-1%, 1/8W	484014	91637	CMF5540R2F	REF		
R3	RES, MF, 40.2 +/-1%, 1/8W	484014	91637	CMF5540R2F	REF		
R4	RES, COMP, 470 +/-5%. 1/4W	147983	01121	CB4715	REF		
R5	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	1		
R6	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	4		
R7	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R8	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R9	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
U1	IC, MOS, DECODER (INSTALLED IN TEST)	407981	12040	MM74C42N	1	1	
UX1	SOCKET, IC, 16-PIN DIP	276535	91506	316AG39D	1		

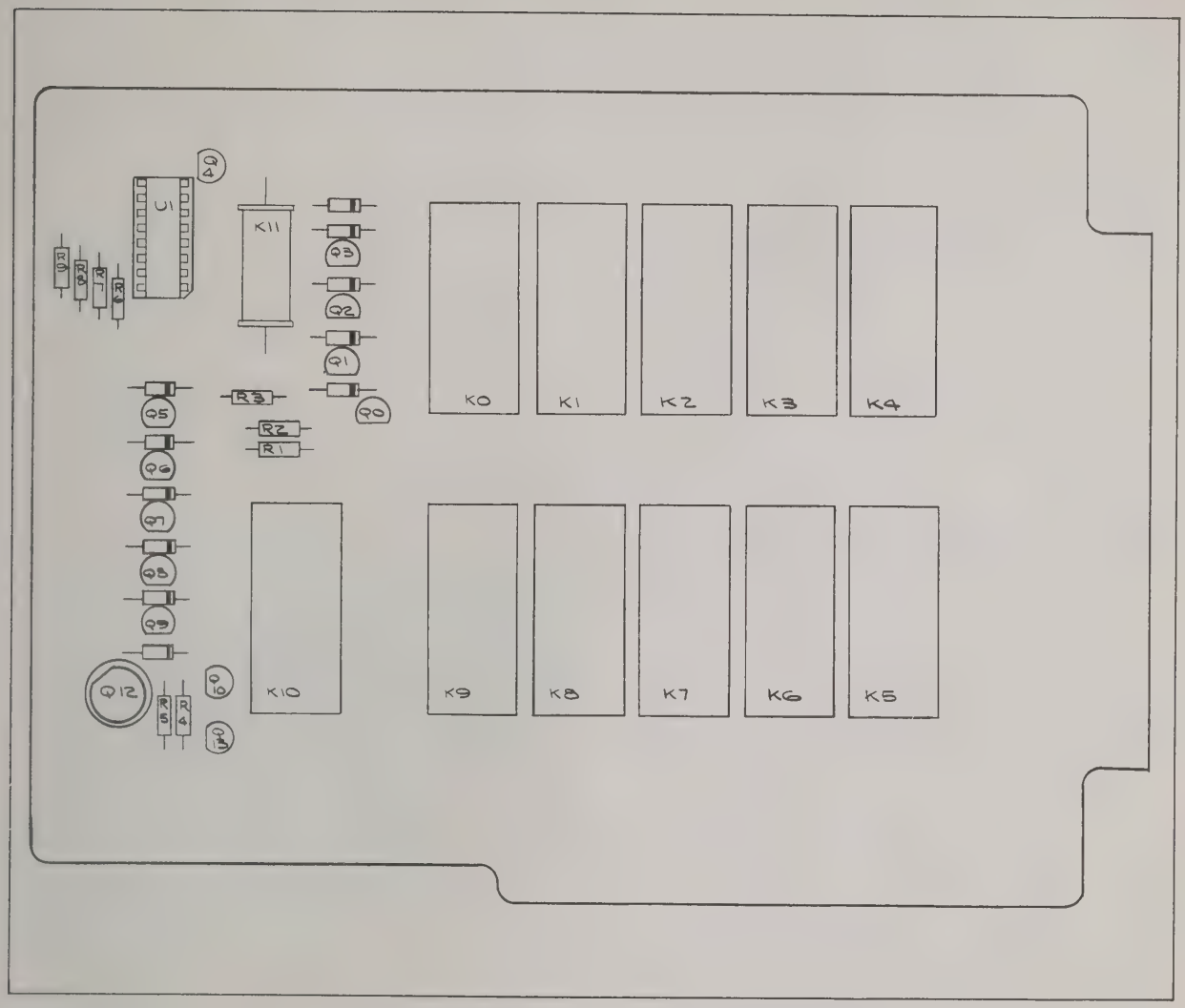

Figure 610-5. General Purpose Scanner PCB Assembly

Option -050
IEEE-488 Interface

650-1. INTRODUCTION

650-2. The IEEE-488 Interface (Option -050) provides the 2204A with a remote control port capable of responding to the asynchronous transfer of character-serial ASCII control data by way of an IEEE-488-1975 standard control bus. The control bus is bidirectional and can be driven by a variety of program sources, such as, a computer or a system controller. Since the 2204A will respond to (listen), but not issue control data (talk), it is defined as a listen only device. A unique address code (1 of 31) is assigned (by the user) to the interface so that all control data on the bus is ignored by the 2204A unless it is preceded by the proper listen address: A series of handshake lines ensure the asynchronous transfer of data regardless of data speed.

650-3. Connection of the 2204A to the system data bus is made with a 24-pin cable that conforms to the IEEE-488 standard.

650-4. SPECIFICATIONS

650-5. Specifications for the IEEE-488 are given in Section 1 of this manual.

650-6. INSTALLATION

650-7. The 2204A can be equipped with either an IEEE-488 (Option -050) or and RS-232-C (Option -060) Interface PCB. If an IEEE-488 interface is to be installed, it may or may not replace an existing interface pcb. Use the following procedure to install the IEEE-488 Interface PCB Assembly.

1. Access and remove the Front Panel Display PCB Assembly using the access procedure given earlier in Section 4 of this manual.

2. Remove the four screws that hold the existing interface pcb to the Front Panel Display PCB.

3. Carefully separate the two pcb's at connectors J10 and P10.

4. Remove the rear panel screws that anchor the interface connector to the rear panel REMOTE CONTROL DIGITAL I/O port.

5. Plug the IEEE-488 Interface PCB into the Front Panel Display PCB; J10-to-P10.

6. Thread the interface cable along side of the guard housing so that it won't interfere with the installation of the top cover.

7. Position the 24-pin connector in the REMOTE CONTROL DIGITAL I/O port, and anchor it in place using the screws removed earlier.

8. Set switch S1 on the Front Panel Display for the desired IEEE-488 address. See Section 4 of this manual for the instructions necessary to select an address.

9. Install the Front Panel Display PCB and the 2204A top cover.

650-8. INTERFACE INFORMATION

650-9. System Connection

650-10. Connection of the 2204A to the IEEE-488 system bus is made using a 24-pin cable. The cable is available as an accessory and comes in three standard lengths; 1, 2, and 4 meters. See Section 6 for cable descriptions and model numbers. Before a cable is ordered, the system bus should be analyzed to ensure that

the added 2204A will not cause an excessive load. As a rule of thumb, the maximum length of cable that can be used to connect a group of devices is: 2 meters times the number of devices on the system bus, or 20 meters whichever is less. Cables may be interconnected in any manner deemed suitable by the user; i.e., star, linear or combinations thereof.

650-11. Each cable added to the IEEE-488 bus connects all 24 lines of the added interface in parallel with all other devices on the bus. As a result, the cable not only connects the added device, it also physically and electrically extends the bus. Sixteen of the lines are signal lines. The remaining lines are used for signal support, i.e., logic common, signal return and shield. The 16 signal lines are separated into 8 data lines, the data byte transfer (handshake) lines and 5 general interface management lines. The data lines normally carry ASCII control characters and data. Data transfer is asynchronous and is directly controlled by the handshake lines. Thus, data transfer speed varies to accommodate the speed of the sending and receiving devices. Cable pin assignments and signal definitions are given in Table 650-1.

650-12. Basic Listener

650-13. All devices connected to the IEEE-488 bus can be functionally catagorized as controllers, talkers, and listeners. The 2204A qualifies as a listener. A brief description of each function follows:

1. Controller

   A device which assigns who is going to transmit data (talker) and who will receive data (listener). There may be only one controller and it will service all interrupts. A controller may also qualify as a listener or talker.

2. Talker

   A device that will output data to the bus on command. Only on talker can be assigned (addressed) at any one time.

3. Listener

   A device that, when properly addressed, accepts data from the bus. Up to 14 listeners can participate in any simultaneous bus operation.

650-14. Interface Address

650-15. Any address from 0 through 30 may be assigned to the 2204A. The address is assigned by positioning a series of switches on the inside of the 2204A. The selected address is displayed when the unit is intitially energized. Instructions for setting the switch are given in Section 4 of this manual.

650-16. Interface Functions

650-17. The IEEE interface employs the IEEE-488 functions deemed necessary for remote operation of the 2204A Scanner. These include:

SYMBOL	FUNCTION	COMMENTS
AH	Handshake Acceptor	Complete capabilities
L	Listener	Listen only capability
RL	Remote/Local	Complete capabilities
DC	Device Clear	Complete capabilities

650-18. Interface Messages

650-19. The interface will handshake all messages on the bus. However, only the ones listed in Table 650-2 will have an affect on the instrument.

650-20. OPERATION

650-21. Once installed, the IEEE-488 Interface does not require attention from the operator. Programming information is given in Section 2 of this manual.

650-22. THEORY OF OPERATION

650-23. The IEEE-488 interface, as shown in Figure 650-1, consists of a series of four, 4-bit data buffers and an 8-bit tri-state inverter. Two of the inverters (U1 and U2) receive ASCII character-serial data (DI0-DI8) and present it to the input of the tri-state inverter (U6). The inverter is normally in the high impedance state. When the microcomputer (μC) is ready to read input data it issues a Port 0 Enable and a read (RD) command. This enables the tri-state buffer causing the 8-bit character to be placed onto the μC's Data Bus. The IEEE handshake lines (three) and general interface management lines (five) are input/output to and from the μC by data buffers U4 and U5. Buffered input lines includes: REN, DAV, ATN, and IFC. Buffered output lines include: RFD, DAC, EOI, and SRQ. All handshake and management routines are handled by the μC.

650-24. MAINTENANCE

650-25. Calibration and/or adjustment of the IEEE-488 Interface PCB is not required. The performance of the interface can be checked using the Remote Test Procedure given earlier in Section 4 of this manual.

650-26. LIST OF REPLACEABLE PARTS

650-27. A list of replaceable parts for the IEEE-488 Interface is given in Table 650-3. Refer to Section 5 of this manual for ordering information.

⊗ CAUTION

Indicated devices are subject to damage by static discharge.

Table 650-1. Interface Cable Pin Assignments

PIN	MNEMONIC	FUNCTION	COMMENTS
1	DIO1	DATA	
2	DIO2	DATA	
3	DIO3	DATA	
4	DIO4	DATA	Data input/output lines. Message bytes are carried on the DIO lines in a bit-parallel byte-serial form, asynchronous, and generally in a bidirectional manner.
13	DIO5	DATA	
14	DIO6	DATA	
15	DIO7	DATA	
16	DIO8	DATA	
5		End or Identify	Used to indicate the end of a multiple byte message.
6		Data Available	Is asserted TRUE by the sender of data when NRFD goes TRUE, remains TRUE until NDAC is sent TRUE by the data receiver.
7		Not Ready For Data	When all devices are ready to receive data this line goes high. Remains high until DAV is sent TRUE.
8		Not Data Accepted	When all receiving devices are through with the data on the bus, this line goes high, indicating that the sender may remove the data and set DAV low. When DAV goes to the receiving devices then pull NDAC low again.
9		Interface Clear	Sent high by the controller. It places all device interfaces in a known quiescent state.
10		Service Request	This line is used by any device to get the attention of the controller.
11		Attention	Used by the controller to notify all other devices what type of message (interface versus device dependent) is on the data bus. When ATN is TRUE, messages sent are interface messages and all devices capable of receiving messages must handshake the transfer. When false, device dependent messages are sent and o only devices that have been addressed remain active.
12		Shield*	Surrounds all conductors.
17		Remote Enable	Must be TRUE to place instruments into remote. Once in Remote, if REN goes false all instruments must go to local.
18	GND	Return to DAV	
19	GND	Return to NRFD	
20	GND	Return to NDAC	
21	GND	Return to IFC	
22	GND	Return to SRQ	
23	GND	Return to ATN	
24	GND	Logic common for DIO1-DIO8, EOI and REN	

* The cable shield is internally routed to a banana jack on the rear of the Scanner adjacent to the line connector.

Table 650-2. Interface Messages

MESSAGE	MNEMONICS	MESSAGE CODING	1	2	3	4
My Listen Address	MLA	00 thru IE		X	X	X
Unlisten	UNL	3F	X			
Local Lockout	LLO	11	X		X	
Go To Local	GTL	01			X	
Device Clear	DCL	14	X			
Selected Device Clear	SDC	04		X		

1 = Universal Command

2 = Address Command

3 = Messages that affect the interface while in local

4 = Receiving MLA will address the interface or a listener and place the interface (and 2204A) into remote if REN is sent true.

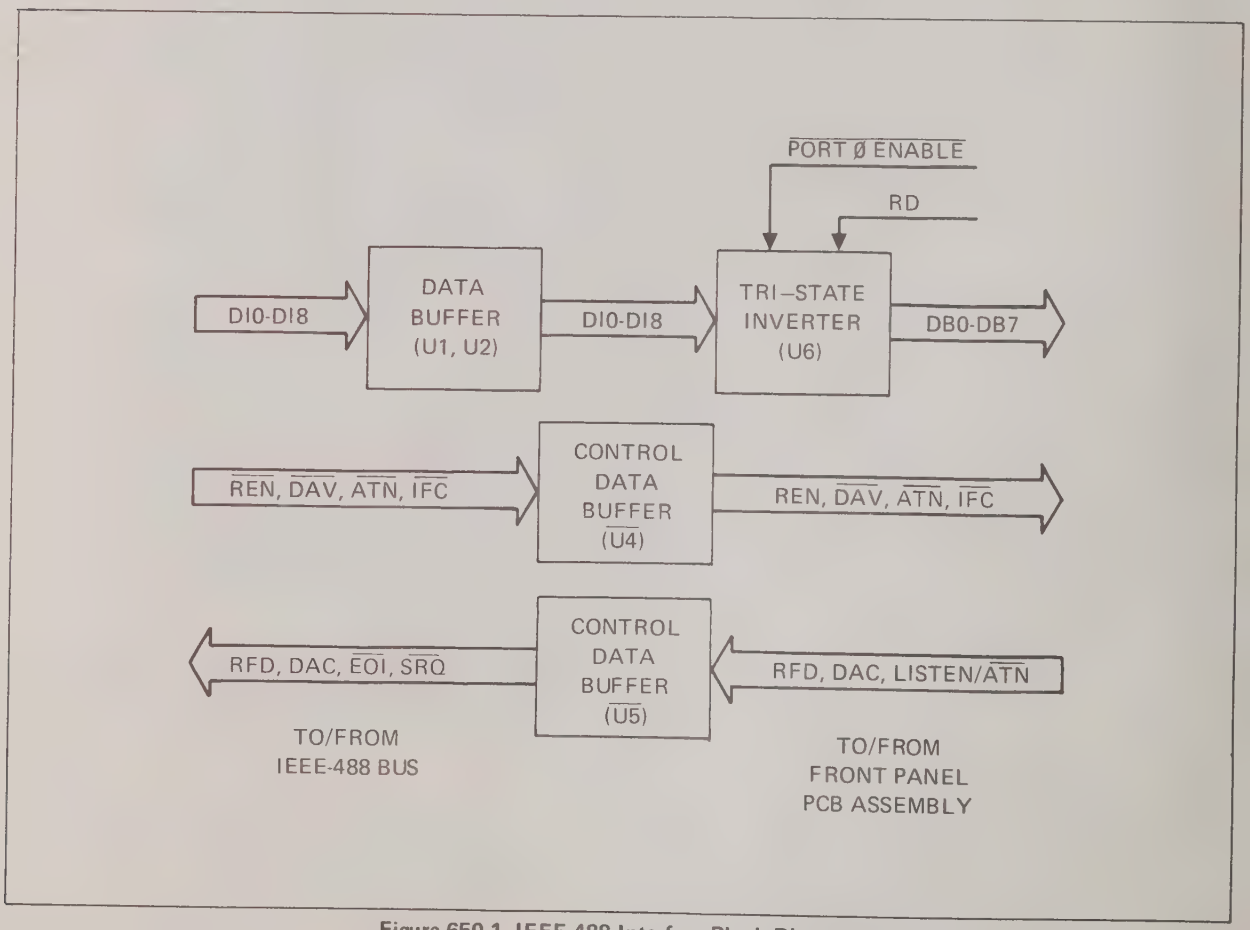

Figure 650-1. IEEE-488 Interface Block Diagram

Table 650-3. IEEE-488 Interface PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-50	⊗IEEE-488 INTERFACE PCB ASSY, OPT.-50 FIGURE 650-2						
C1	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0025KA1	1		
H1	STRAP, NYLON	172080	06383	SST-1M	1		
J10A	CONNECTOR, FEMALE, 12-PIN	417733	30035	SS-109-1-12	2		
U1	⊗IC, MOS, QUAD, INTERFACE BUS TRANSCEIVER	428649	04713	MC3446P	4	1	
U2	⊗IC, MOS, QUAD, INTERFACE BUS TRANSCEIVER	428649	04713	MC3446P	REF		
U3	IC, TTL, QUAD, 2-INPUT, NOR GATE	393041	01295	SN74LS02N	1	1	
U4	⊗IC, MOS, QUAD, INTERFACE BUS TRANSCEIVER	428649	04713	MC3446P	REF		
U5	⊗IC, MOS, QUAD, INTERFACE BUS TRANSCEIVER	428649	04713	MC3446P	REF		
U6	IC, SCHOTTKY	453308	12040	DM81LS96N	1	1	
W1	CABLE ASSEMBLY, IEEE 488	468629	89536	468629	1		

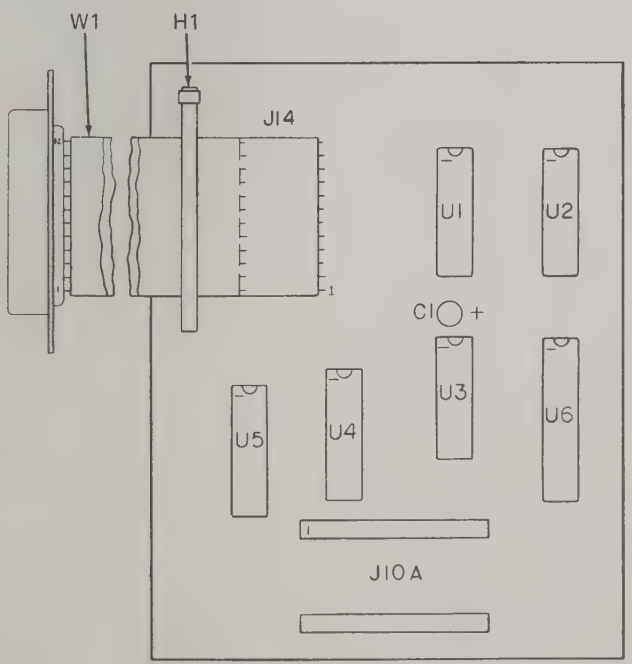

Figure 650-2. IEEE-488 Interface PCB Assembly

Option -060
RS-232-C Interface

660-1. GENERAL

660-2. EIA Standard RS-232-C provides the electronics industry with the ground rules necessary for independent manufacturers to design and produce both data terminal and data communication equipment that conforms to a common interface requirement. As a result, a data communications system can be formed by connecting an RS-232-C data terminal (such as, the 2204A) to an RS-232-C data communication peripheral (such as, a TTY, MODEM, computer, etc.). This works fine on paper. However, in practice, the user must be aware of the subtleties of serial binary data interchange to ensure that any two pieces of RS-232-C equipment will be compatible. For example, the two instruments must share at least one of the features from each of the following characteristics.

1. Timing Format - Synchronous or Asynchronous.

2. Transmission Mode - Simplex, half-duplex or full duplex.

3. Baud Rate (bits per second) - 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600.

4. Bits per character - 5, 6, 7, 8.

5. Parity Bit -Odd, even, hi, low, not used.

6. Data Interface Levels - EIA or 20 mA current loop.

660-3. Timing formats conforming to both synchronous and asynchronous operation are shown in Figure 660-1. In asynchronous operation each character is bracketed by both start and stop bits. These bits separate the characters and synchronize both the transmission and receipt of data. When data is not being sent the data line is held high. In synchronous operation a sync character is sent prior to each data stream (a data stream usually consists of a block of characters). When the line is idle a fill or sync character is continuously transmitted.

660-4. Transmission mode is an overall system requirement. It defines the communication ability of both instruments in the system configuration. Simplex indicates data transmission in one direction only. Half-duplex permits two way communication, but not simultaneously. Simultaneous transmission of data in both directions defines the full duplex system. Obviously, an instrument capable of full-duplex operation can be down graded to simplex operation. However, the reverse is not possible without degrading the system capability.

660-5. Baud rate is usually selectable on the RS-232-C Interface. If it is not, the manufacturer usually offers a choice when the instrument is purchased.

660-6. Character format (bits per character and parity) is somewhat flexible between instruments. Investigate the requirement of both instruments before committing either to a system configuration.

660-7. Data interface levels can occur as either EIA voltage levels or as a 20 mA current loop. At times an interface offers both simultaneously. The 20 mA current loop is used almost exclusively for teletypewriter, or paper tape punch/reader interface. EIA voltage levels are: 1 or OFF = -15 to -3V dc, 0 or ON = +3 to +15V dc.

660-8. INTRODUCTION

660-9. The RS-232-C Interface (Option -060) is designed to interface the Model 2204A Scanner with an external RS-232-C data communication instrument,

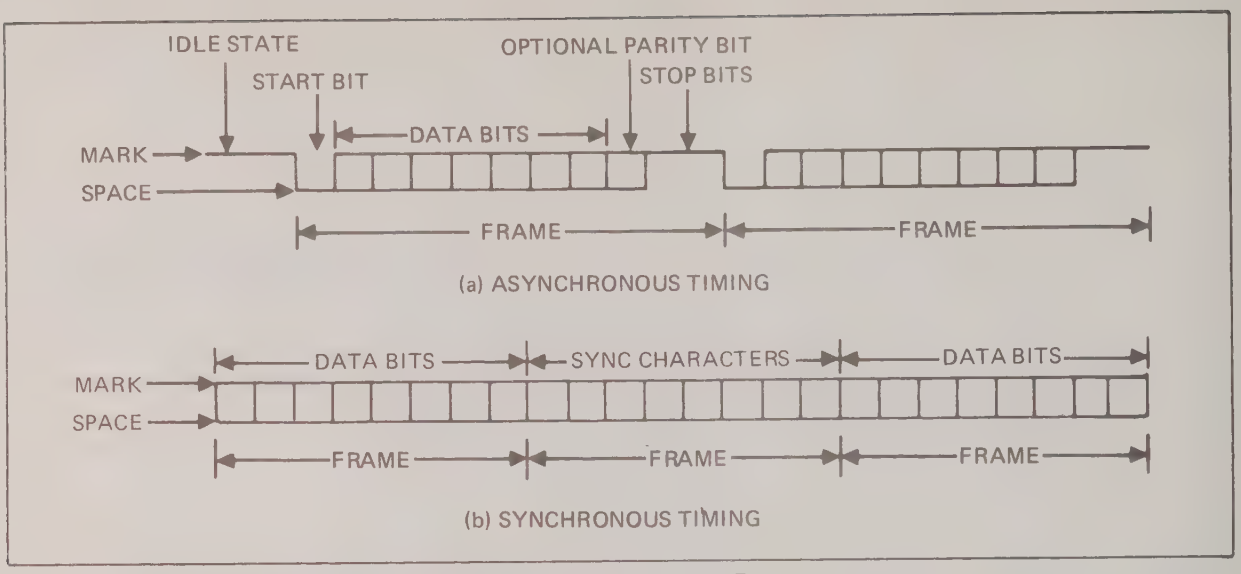

Figure 660-1. RS-232-C Timing Formats

such as a TTY, modem, computer, CRT, etc. It features asynchronous timing, simplex operation, selectable baud rate, and EIA voltage levels. The interface is not addressable and, therefore, responds to all input data.

660-10. Interface connection to the remote data communication instrument is made by way of a rear-panel, 25-pin connector labeled REMOTE CONTROL DIGITAL I/O. The connector is RS-232-C compatible. A mating connector is supplied with the option for use in fabricating an interface cable.

660-11. SPECIFICATIONS

660-12. Specifications for the RS-232-C Interface are given in Section 1 of this manual.

660-13. INSTALLATION

660-14. The 2204A can be equipped with either an IEEE-488 (Option -050) or an RS-232-C (Option -060) Interface PCB. If an RS-232-C interface is to be installed, it may or may not replace an existing interface pcb. Use the following procedure to install the RS-232-C Interface PCB Assembly.

1. Access and remove the Front Panel Display PCB Assembly using the access procedure. given earlier in Section 4 of this manual.

2. Remove the four screws that hold the existing interface pcb to the Front Panel Display PCB.

3. Carefully separate the two pcb's to connects J10 and P10.

4. Remove the rear panel screws that anchor the interface connector to the rear panel REMOTE CONTROL DIGITAL I/O port.

5. Plug the IEEE-488 Interface PCB into the Front Panel Display PCB; J10-to-P10.

6. Thread the interface cable along side of the guard housing so that it won't interfere with the installation of the top cover.

7. Position the 25-pin connector in the REMOTE CONTROL DIGITAL I/O port, and anchor it in place using the screws removed earlier.

8. Install the Front Panel Display PCB and the 2204A top cover.

660-15. INTERFACE INFORMATION

660-16. Input connection to the RS-232-C Interface is made using a 25-pin female connector, type DB255. The connector is available from Fluke as p/n 312579. A compatible hood is also available as p/n 320184. Connections necessary to complete the cable are limited to pins 2 and 7. Pin 2 is Transmitted Data and pin 7 is Signal Ground. Use a twisted pair to form the cable between the bit-serial data source and the interface connector.

660-17. OPERATION

660-18. Once installed, the RS-232-C Interface does not require attention from the operator. programming information is given in Section 2 of this manual.

660-19. THEORY OF OPERATION

660-20. The RS-232-C Bit-Serial Interface PCB Assembly is designed to enable the 2204A to be controlled by a remote bit-serial data source such as a computer, CRT, TTY, etc. Input data requirements include EIA voltage levels, 8-bit ASCII control characters, and two stop bits. Data is received in the asynchronous mode, and baud rates from 100 through 4800 are switch selectable. Parity (the eighth bit of each character) is not checked and therefore may be odd, even, high, or low.

660-21. The interface assembly, as shown in Figure 660-2, consists of a universal asynchronous receiver transmitter (UART), an EIA line receiver, and a programmable bit-rate generator. The UART receives TTL, character-serial data via the EIA line receiver and enters it into memory in synchronous with the baud rate clock. When a complete character is stored, the UART issues a Data Ready pulse to the microcomputer (μC) which, in turn, issues read and port 0 enable commands. These commands cause the UART to place the stored ASCII character onto the Data Bus so that it can be read by the μC.

660-22. The bit-serial data rate is controlled by an onboard, programmable bit-rate generator which runs continuously at 16 times the programmed baud rate. This increased frequency is necessary to satisfy the UART which must synchronize incoming data. Program data for the bit-rate generator is received from the μC which, in turn, receives baud-rate information from the baud rate switch on the Front Panel Display PCB Assembly.

660-23. MAINTENANCE

660-24. Calibration and/or adjustment of the RS-232-C Interface PCB is not required. The performance of the interface can be checked using the Remote Test Procedure given earlier in Section 4 of this manual.

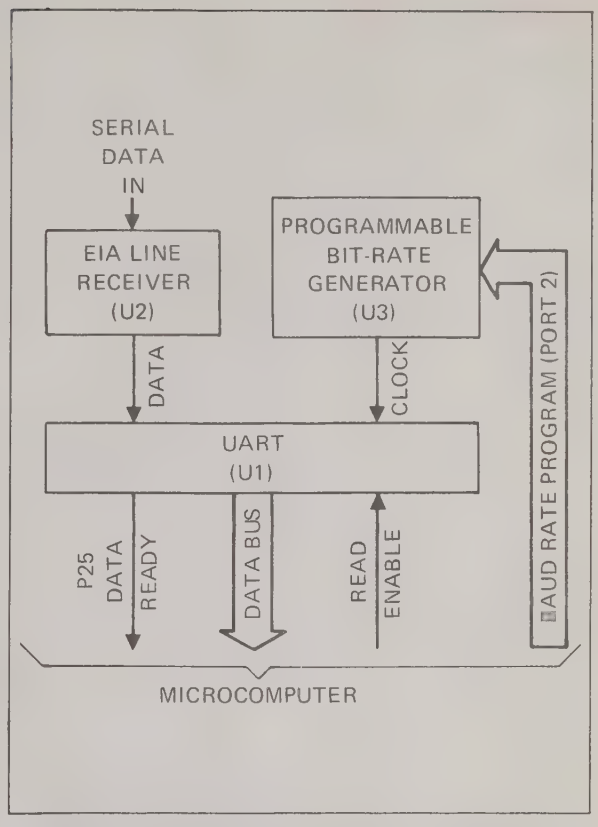

Figure 660-2. Bit Serial Interface Block Diagram

660-25. LIST OF REPLACEABLE PARTS

660-26. A list of replaceable parts for the RS-232-C Interface is given in Table 660-1. Refer to Section 5 of this manual for ordering information.

⊗ CAUTION

Indicated devices are subject to damage by static discharge.

Table 660-1. RS-232-C Interface PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-60	Ⓧ RS-232-C INTERFACE PCB ASSY, OPT.-60 (2204A-4011) FIGURE 660-3						
C1	CAP, TA, 10 UF +/-20%, 20V	193623	56289	196D106X0020KA1	1		
C2	CAP, MICA, 56 PF +/-5%, 500V	148528	72136	DM15F560J	2		
C3	CAP, MICA, 56 PF +/-5%, 500V	148528	72136	DM15F560J	REF		
H1	STRAP, NYLON	172080	06383	SST-1M	2		
J10B	CONNECTOR, FEMALE, 12-PIN	417733	30035	SS-109-1-12	2		
R1	RES, COMP, 10M +/-5%, 1/4W	194944	01121	CB1065	1		
U1	Ⓧ IC, C-MOS, RECEIVER, TRANSMITTER	453464	32293	1M6402CPL	1	1	
U2	IC, TTL, MSI, DUAL COMMUNICATIONS	354704	18324	8T16A	1	1	
U3	Ⓧ IC, C-MOS, PROGRAMABLE, BIT RATE GEN	418731	07263	F4702/34702	1	1	
U4	IC, TTL, QUAD, 2-INPUT OR GATE	393108	01295	SN74LS32N	1	1	
W1	CABLE ASSEMBLY, RS-232-C	468637	89536	468637	1		
Y1	XTAL, 2.4576 MHZ	474825	89536	474825	1		

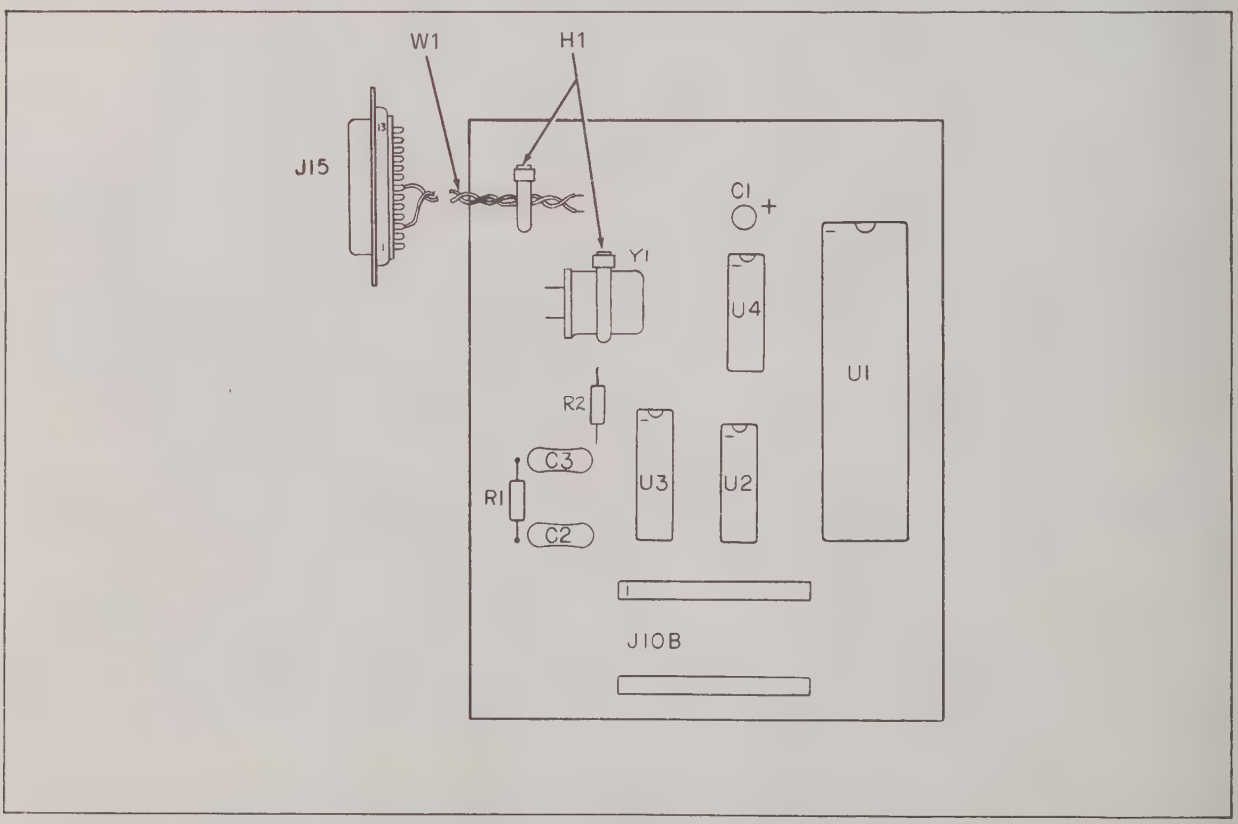

Figure 660-3. RS-232-C Interface PCB Assembly

Section 7
General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5. The following information is presented in this section:

List of Abbreviations
Federal Supply Codes for Manufacturers
Fluke Technical Service Centers — U.S. and Canada
Sales and Service Locations — International
Sales Representatives — U.S. and Canada

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
^{o}C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
^{o}F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^{9})
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^{3})
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^{6})
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(—) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
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71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

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Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

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Guardian Electric Mfg. Co.
Chicago, Illinois

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Quan Nichols Co.
Chicago, Illinois

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Radio Switch Corp.
Marlboro, New Jersey

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Signalite Div.
General Instrument Corp.
Neptune, New Jersey

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Mt. Kisko, New York

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Electro-Midland Corp., Mepco Div.
A North American Phillips Co.
Morristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183 - use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Stevens, Arnold Inc.
South Boston, Massachusetts

81073
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La Grange, Illinois

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Div. of Litton Industries Inc.
Oakville, Connecticut

81439
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81741
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82879
ITT Royal Electric Div.
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83003
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83058
Carr Co., The United Can Div.
of TRW
Cambridge, Massachusetts

83298
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Electric Power Division
Eatontown, New Jersey

83330
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Battery Products Div.
formerly Consumer Products Div.
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Arco Electronics
Great Neck, New York

84411
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TRW Capacitors
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Rockville, Maryland

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Peabody, Massachusetts

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of Malden Inc.
Stoneham, Massachusetts

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Electronic Components Div.
Harrison, New Jersey

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Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
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88690
Replaced by 04217

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89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co. Div of
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Indianapolis, Indiana

90211 - use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
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91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

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Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737 - use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
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91802
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Edgewater, New Jersey

91833
Keystone Electronics Corp.
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91929
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Freeport, Illinois

91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

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Vitramon Inc.
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Microwave Devices Plant
Franklin, Indiana

95987
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96733
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San Fernando, California

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Gulton Industries Inc.
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formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
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Manhasset, New York

97540
Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic Hdware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect. Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779 - use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

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Paligono Industrial Urtinsa
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Necatibey Cad 92/2
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Tehran, Iran
Tel. 828294

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Tokyo Electron Lab. Inc.
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Midori-ku
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4515 Culver Road
Zip: 14622
Tel. (716) 266-1400

NORTH CAROLINA
Greensboro
BCS Associates, Inc.
P.O. Box 9619
1310 Beaman Place
Zip: 27408
Tel. (919) 273-1918

OHIO
Cleveland
WKM Associates, Inc.
7913 S. Suburban Road
Dayton, OH
Zip: 45459
Tel. (513) 434-7500

PENNSYLVANIA
Philadelphia
Mid-Atlantic Sales Group
John Fluke Mfg. Co., Inc.
Suite H
1010 West 8th Street
King of Prussia, PA
Zip: 19406
Tel. (215) 265-4040

Pittsburgh
WKM Associates, Inc.
90 Clairton Blvd.
Zip: 15236
Tel. (412) 892-2953

TEXAS
Austin
Barnhill Two, Inc.
111 W. Anderson Lane
Suite 221
Zip: 78752
Tel. (512) 451-0217

Dallas
Barnhill Two, Inc.
1101 Executive Dr. East
Suite 110
Richardson, TX
Zip: 75081
Tel. (214) 231-9012

Houston
Barnhill Two, Inc.
10606 Hempstead Highway
Suite 132
Zip: 77092
Tel. (713) 688-9971

UTAH
Salt Lake City
Barnhill Three, Inc.
54 West 2100 South
Suite 3
Zip: 84115
Tel. (801) 485-8121

WASHINGTON
Seattle
Instrument Specialists Sales Group
John Fluke Mfg. Co., Inc.
691 Strander Blvd.
Zip: 98188
Tel. (206) 575-3765

CANADA

ALBERTA
Calgary
Allan Crawford Associates Ltd.
2280 - 39th Ave. N.E.
Calgary, Alberta
T2E 6P7
Tel. (403) 276-9658

BRITISH COLUMBIA
Vancouver
Allan Crawford Associates Ltd.
3795 William St.
Burnaby, B.C.
V5C 3H3
Tel. (604) 294-1326

NOVA SCOTIA
Halifax
Allan Crawford Assoc., Ltd.
800 Windmill Rd.
Burnside Industrial Park
Dartmouth, NS
Zip: B3B 1L1
Tel. (902) 469-7865

ONTARIO
Toronto
Allan Crawford Assoc., Ltd
6503 Northam Drive
Mississauga, ON
Zip: L4V 1J5
Tel. (416) 678-1500

Ottawa
Allan Crawford Assoc., Ltd.
1299 Richmond Road
Zip: K2B 7Y4
Tel. (613) 829-9651

QUEBEC
Montreal
Allan Crawford Assoc., Ltd.
1330 Marie Victorian Blvd. E
Longueuil, P.Q.
Zip: J4G 1A2
Tel. (514) 670-1212

All of the above Fluke Sales Offices carry local stocks of low-cost Digital Multimeters (Models 8000A, 8030A, 8040A), Counters (Model 1900A), Digital Thermometers (Models 2160A, 2170A, 2165A, 2175A) and the Universal Temperature Probe (Model 80T-150). These same products are available from the following distributors:

Brownell Electronics
Atlanta, GA (404) 762-5181
Charlotte, NC (704) 394-4341
Memphis, TN (901) 323-8554
Nashville, TN (615) 889-8230
Orlando, FL (305) 843-6770
Mobile, AL (205) 479-5405

The Mancib Company
Boston, MA (617) 272-9450
Middletown, CT (203) 346-6646

Elmar Electronics
San Francisco, CA (415) 961-3611
Denver, CO (303) 287-9611

Pioneer Standard
Cleveland, OH (216) 587-3600
Dayton, OH (513) 236-9900
Indianapolis, IN (317) 849-7300
Pittsburgh, PA (412) 782-2300
Detroit, MI (313) 525-1800

Liberty Electronics
El Segundo, CA (213) 322-8100
San Diego, CA (714) 565 9171
Phoenix, AZ (602) 257-1272
Seattle, WA (206) 763-8200
Albuquerque, NM (505) 299-8293
Beaverton, OR (503) 644-4783

Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

CHANGES

There are no backdating changes at his printing. All pcb assemblies are documented at their original revision level.

Table 7A-1. Manual Status and Backdating Information

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																						
			—	A	B	C	D	E	F	G	H	J	K	L	M	N	P								
A1	Front Panel Display PCB Assembly	468066	X																						
A2A1	Mother Board PCB Assembly	468132	●	X																					
A2A2	Extended Bus PCB Assembly	468074	●	X																					
A2A3	Power Supply PCB Assembly	468058	●	X																					
–50	IEEE-488 Interface PCB Assembly	469254	X																						
–60	RS-232-C Interface PCB Assembly	469247	X																						

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
— = No revision letter on the PCB.

Section 8
Schematic Diagrams

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UL	Unguarded Logic
GL	Guarded Logic
DB0-DB7	Data Bus (7-Bit)
REN	Remote Enable
WR	Write
T0	Clock Output
ALE	Address Latch Enable
RD	Read
PORT 0 EN	Port 0 (Zero) Enable
IFC	Interface Clear
WR DIS	Write Disabled
SD	Serial Data
SC	Serial Clock (BCD)
CS0 thru CS3	Channel Select (BCD)
DS0 thru DS3	Decade Select (BCD)
HS0 thru HS3	Hundreds Select
REF COM	Reference Common
HIGH	Analog High
LO	Analog Low
A/D COM	Analog-to-Digital Common
BS0 thru BS9	Block Select 0 thru 9
A COM	Analog Common
DIO	Data Input/Output
DAV	Data Valid
ATN	Attention
RFD	Ready For Data
DAC	Data Accepted
EOI	End Or Identify
SRQ	Service Request

Figure 8-1. Mnemonics

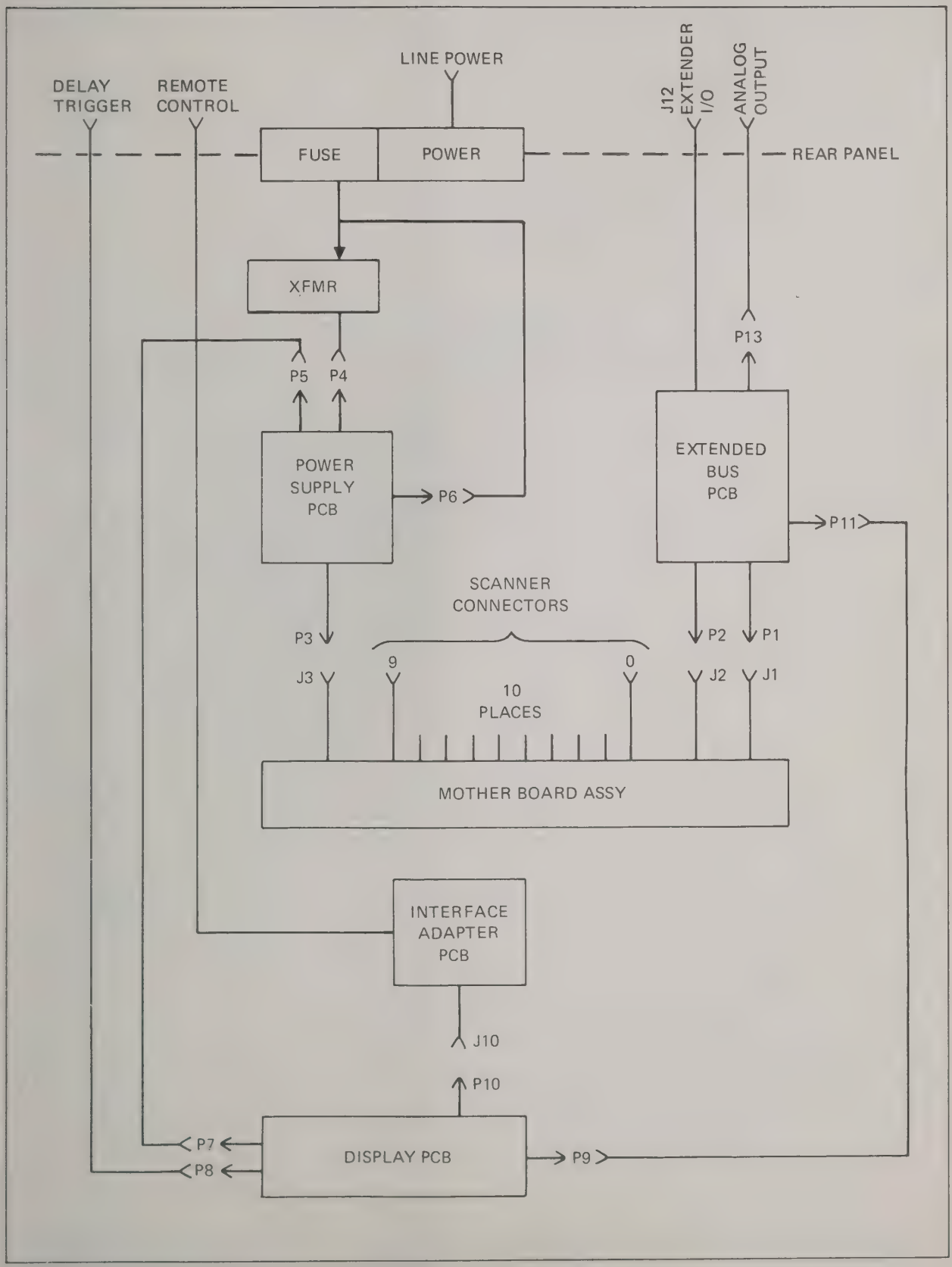
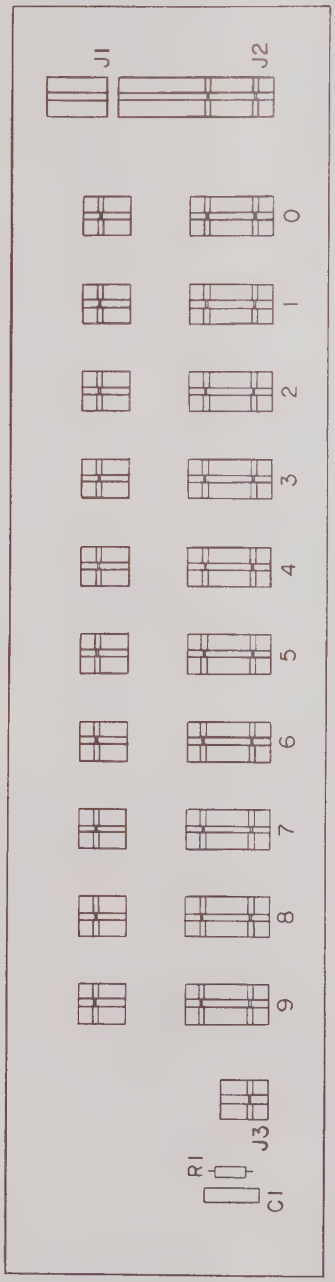
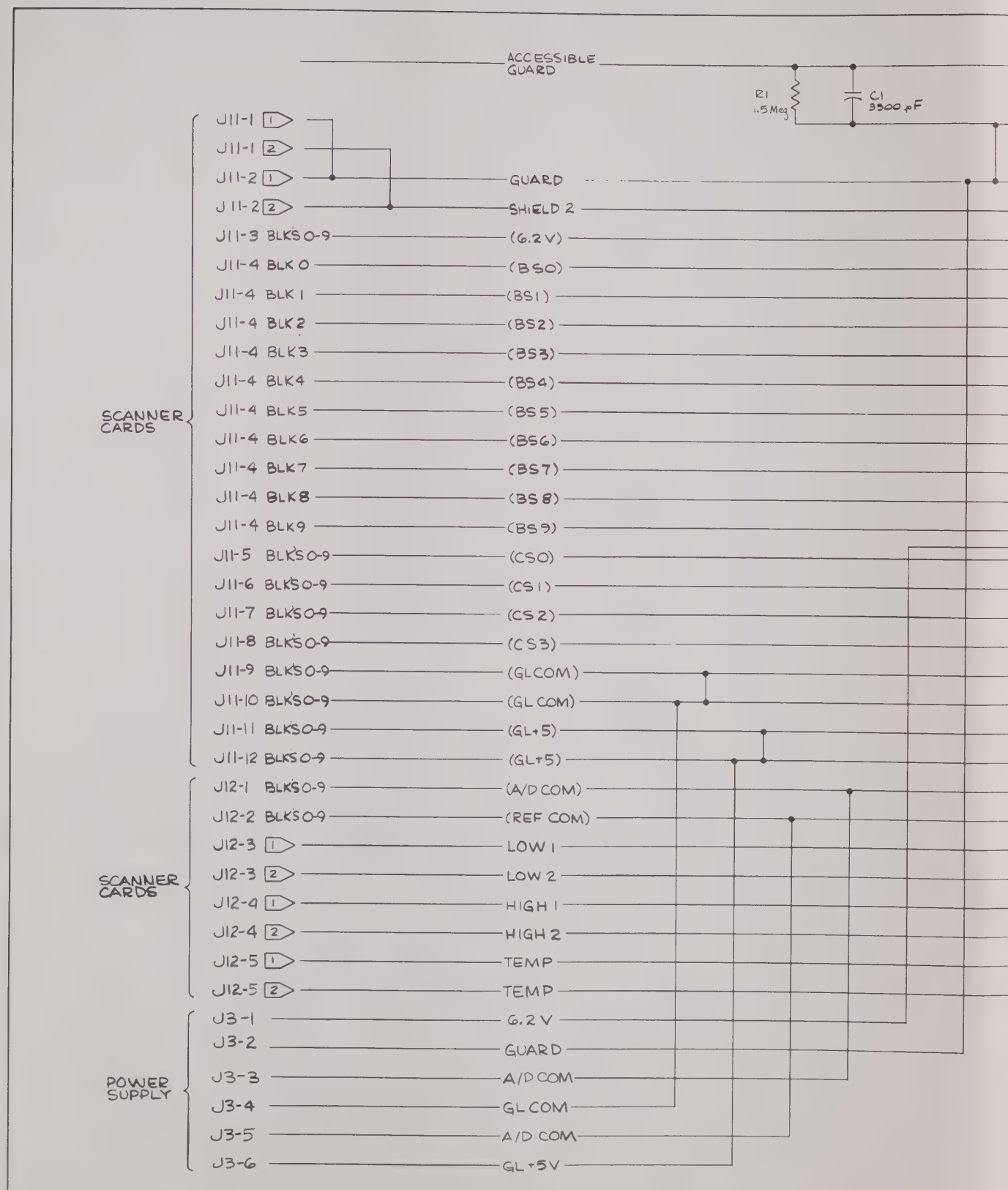


Figure 8-2. 2204A Interconnect Diagram



2204A-1701

Figure 8-3. A2A1 Mother Board PCB Assembly


ACCESSIBLE GUARD
R1 1.5 Meg
C1 3300 pF
SCANNER CARDS
J11-1 1
J11-1 2
J11-2 1
J11-2 2
GUARD
SHIELD 2
J11-3 BLKS 0-9
(6.2 V)
J11-4 BLK 0
(BS0)
J11-4 BLK 1
(BS1)
J11-4 BLK 2
(BS2)
J11-4 BLK 3
(BS3)
J11-4 BLK 4
(BS4)
J11-4 BLK 5
(BS5)
J11-4 BLK 6
(BS6)
J11-4 BLK 7
(BS7)
J11-4 BLK 8
(BS8)
J11-4 BLK 9
(BS9)
J11-5 BLKS 0-9
(CS0)
J11-6 BLKS 0-9
(CS1)
J11-7 BLKS 0-9
(CS2)
J11-8 BLKS 0-9
(CS3)
J11-9 BLKS 0-9
(GL COM)
J11-10 BLKS 0-9
(GL COM)
J11-11 BLKS 0-9
(GL+5)
J11-12 BLKS 0-9
(GL+5)
SCANNER CARDS
J12-1 BLKS 0-9
(A/D COM)
J12-2 BLKS 0-9
(REF COM)
J12-3 1
LOW 1
J12-3 2
LOW 2
J12-4 1
HIGH 1
J12-4 2
HIGH 2
J12-5 1
TEMP
J12-5 2
TEMP
POWER SUPPLY
J3-1
6.2 V
J3-2
GUARD
J3-3
A/D COM
J3-4
GL COM
J3-5
A/D COM
J3-6
GL+5V

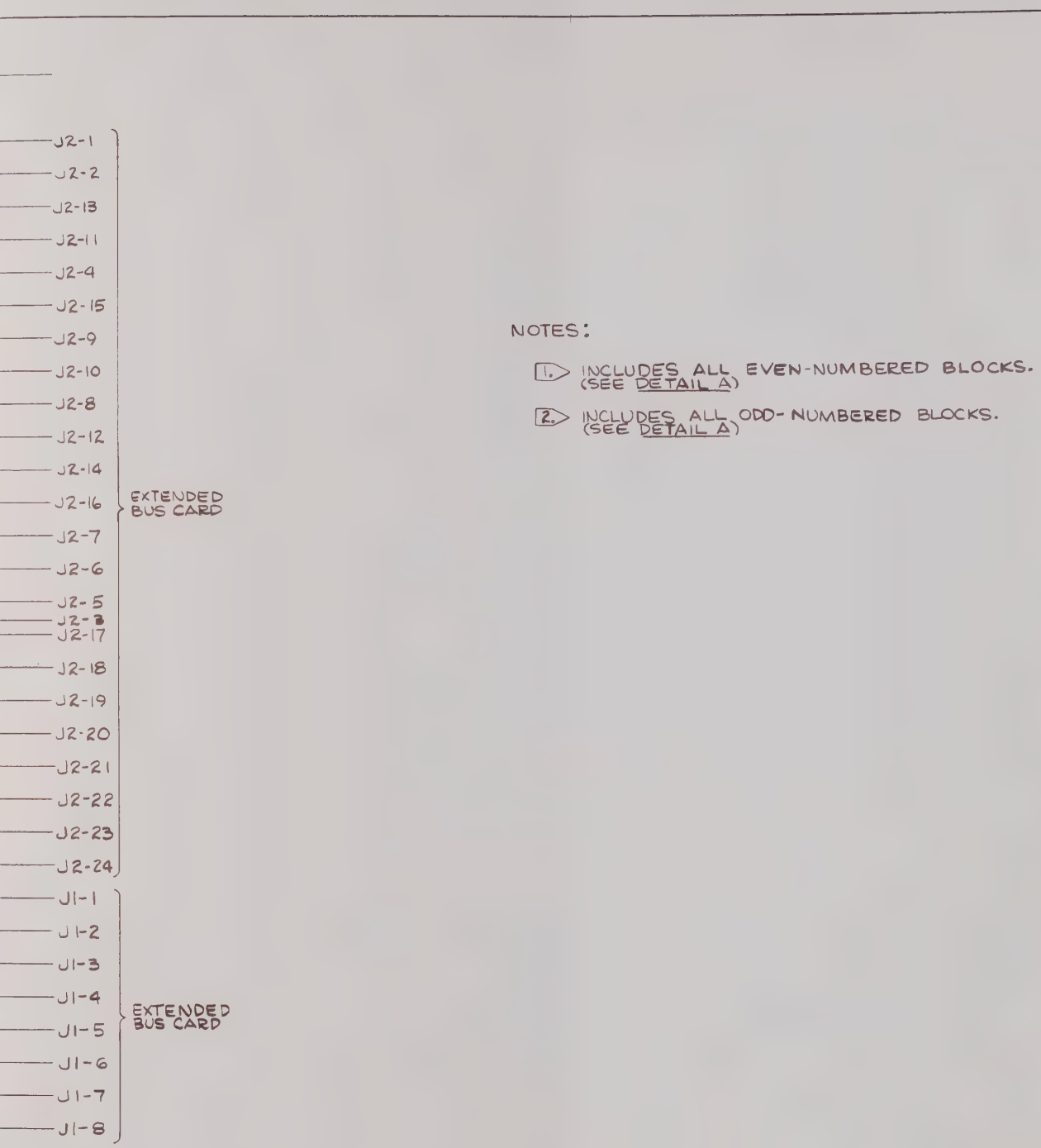
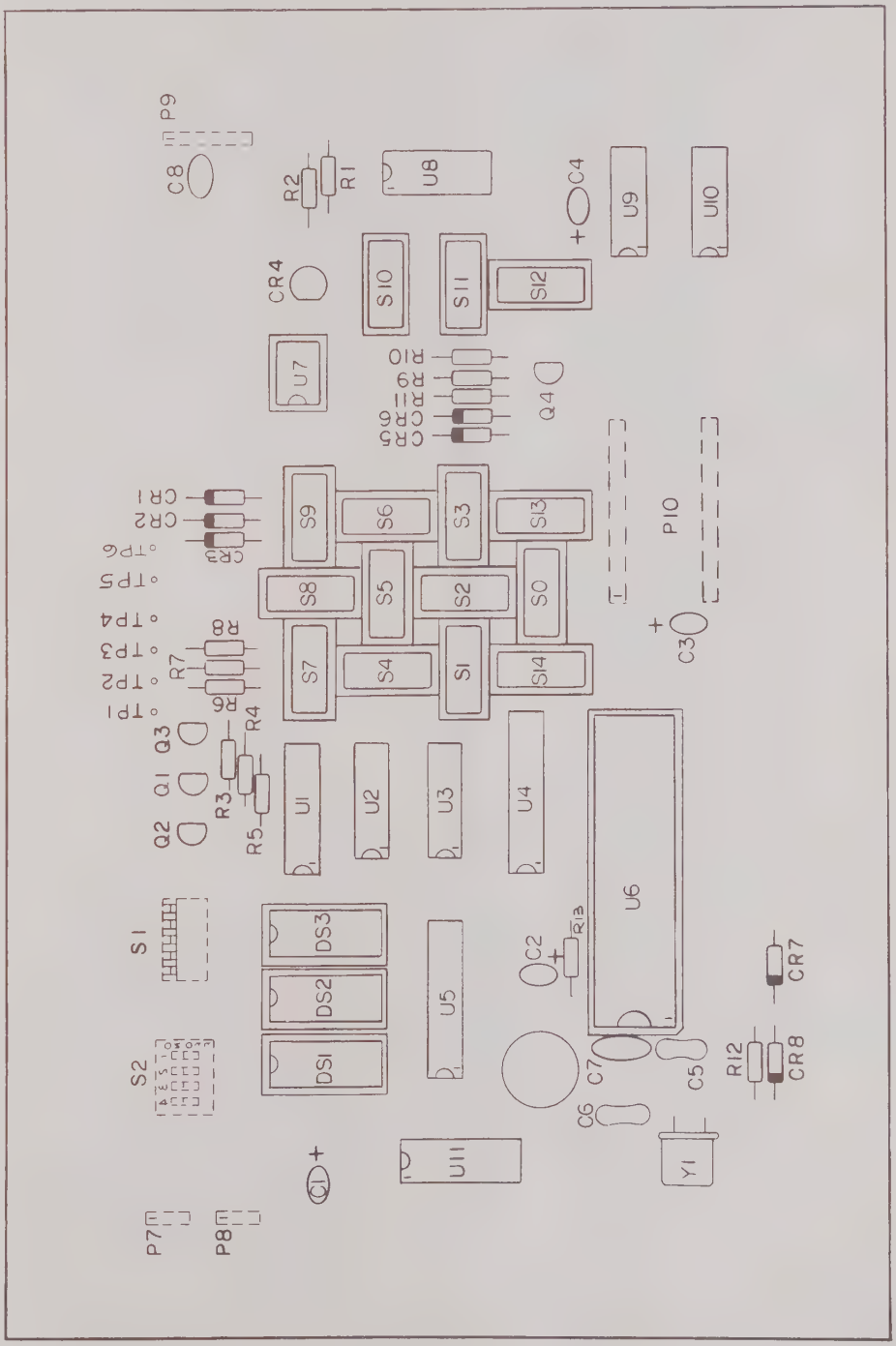
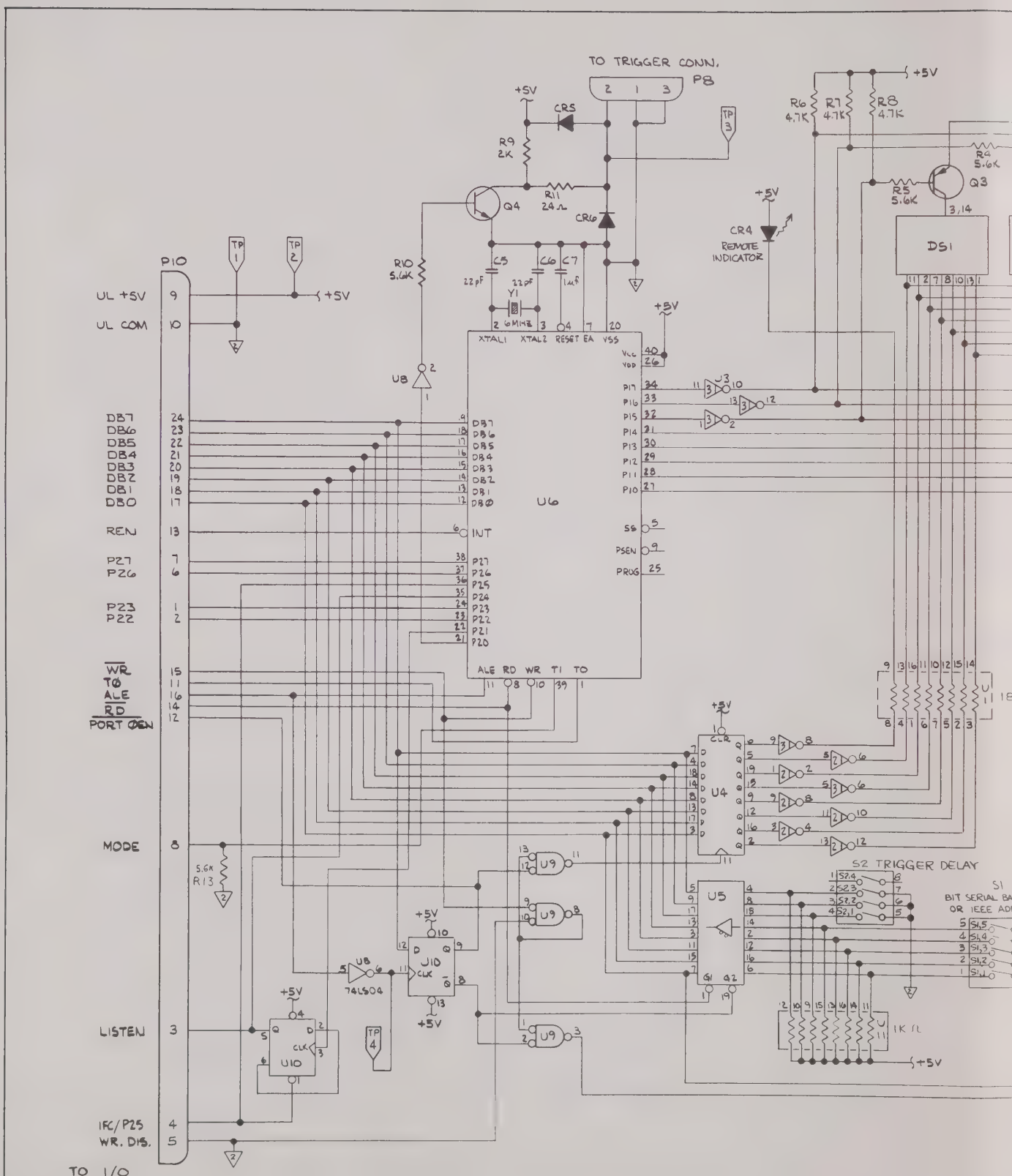


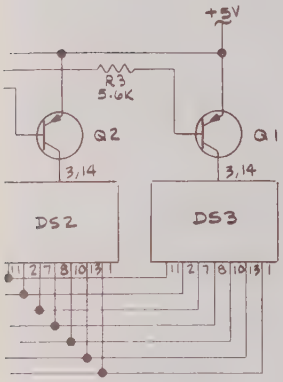
Figure 8-3. A2A1 Mother Board PCB Assembly (cont)

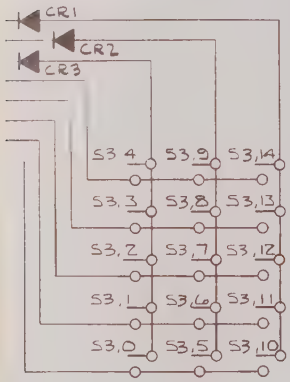


2204A-1710

Figure 8-4. A1 Front Panel Display PCB Assembly


TO TRIGGER CONN. P8
+5V
CR5
R9 2K
Q4
R11 24Ω
CR6
R10 5.6K
C5 22pF
C6 22pF
Y1 2.6MHz
C7 1μF
XTAL1 XTAL2 RESET EA VSS
Vcc 40
Vpp 26
U6
INT 6
SS 5
PSEN 9
PROG 25
P17 34
P16 33
P15 32
P14 31
P13 30
P12 29
P11 28
P10 27
P27 38
P26 37
P25 36
P24 35
P23 24
P22 23
P21 22
P20 21
ALE RD WR T1 T0
11 8 10 39 1
R6 4.7K
R7 4.7K
R8 4.7K
R4 5.6K
R5 5.6K
Q3
CR4 REMOTE INDICATOR
DS1
P10
UL +5V 9
UL COM 10
DB7 24
DB6 23
DB5 22
DB4 21
DB3 20
DB2 19
DB1 18
DB0 17
REN 13
P27 7
P26 6
P23 1
P22 2
WR 15
T0 11
ALE 16
RD 14
PORT EN 12
MODE 8
LISTEN 3
IFC/P25 4
WR. DIS. 5
TO I/O
TP 1
TP 2
TP 3
TP 4
5.6K R13
U8
74LS04
U10
U9
U4
U5
S2 TRIGGER DELAY
S2.4
S2.3
S2.2
S2.1
S1
BIT SERIAL BA
OR IEEE AD
S1,5
S1,4
S1,3
S1,2
S1,1
1K Ω
+5V

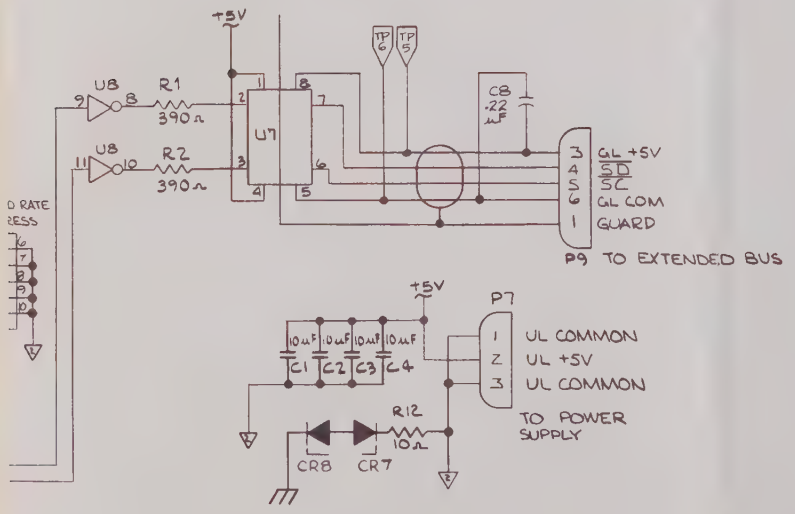




TEST POINT	DESIGNATION
TP1	UL COMMON
TP2	UL + 5 VOLTS
TP3	TRIGGER OUTPUT
TP4	CLOCK
TP5	GL + 5 VOLTS
TP6	GL COMMON

SWITCH	DESIGNATION
S3,0	0
S3,1	1
S3,2	2
S3,3	3
S3,4	4
S3,5	5
S3,6	6
S3,7	7
S3,8	8
S3,9	9
S3,10	LOCAL
S3,11	T.C. REF JUNCTION
S3,12	INCREMENT
S3,13	ENTER
S3,14	CLEAR

REF #	+5V	GND
U2	14	7
U3	14	7
U4	1,20	10
U5	20	10
U6	40,26	20,7
U8	14	7
U9	14	7
U10	4,10,13,14	7

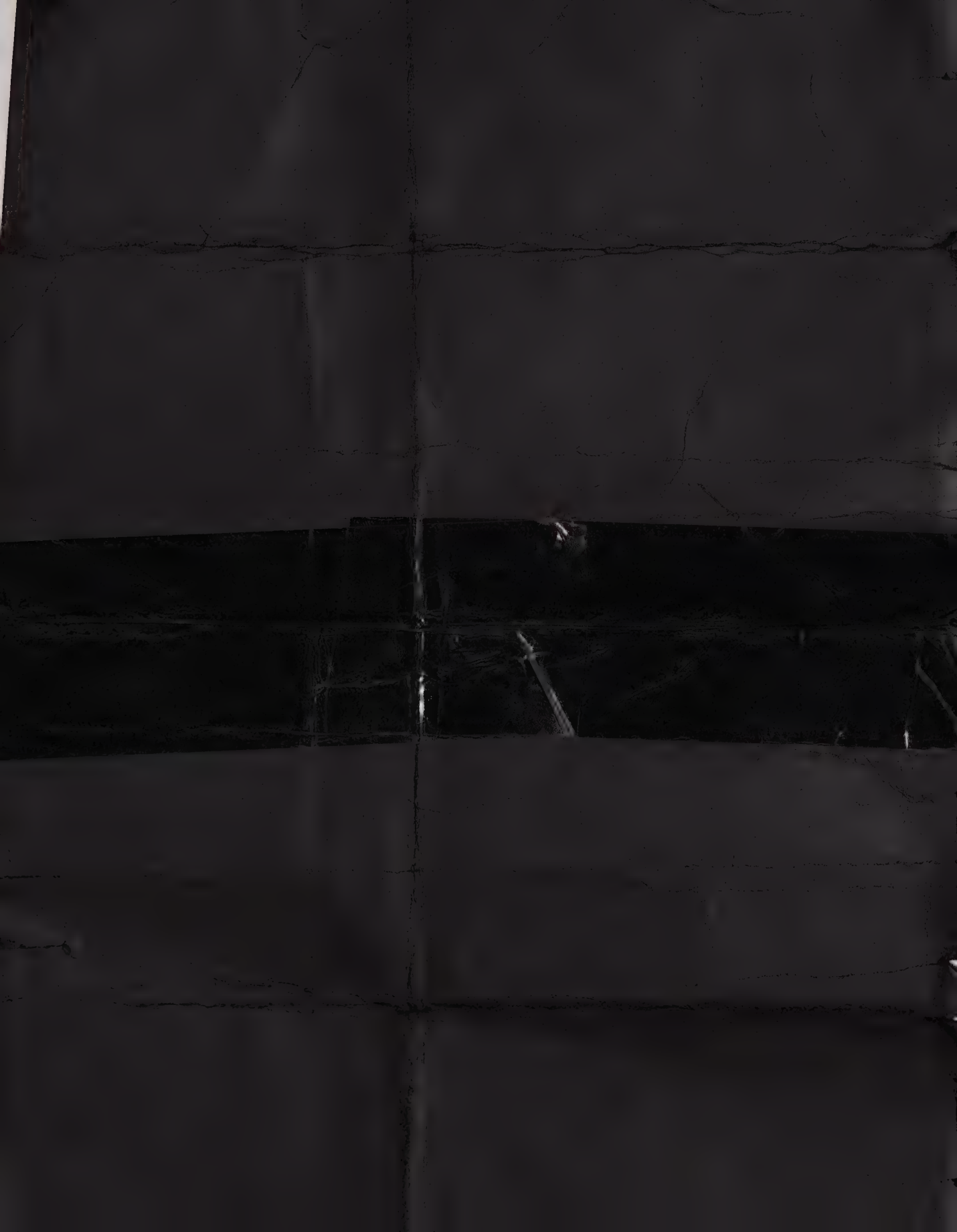


NOTES: UNLESS OTHERWISE SPECIFIED

4. LAST REF. DES. NO'S USED U11, R13, C8, Q4, CR8
5. ▽ = UNGUARDED LOGIC COMMON

2204A-1010

Figure 8-4. A1 Front Panel Display PCB Assembly (cont)



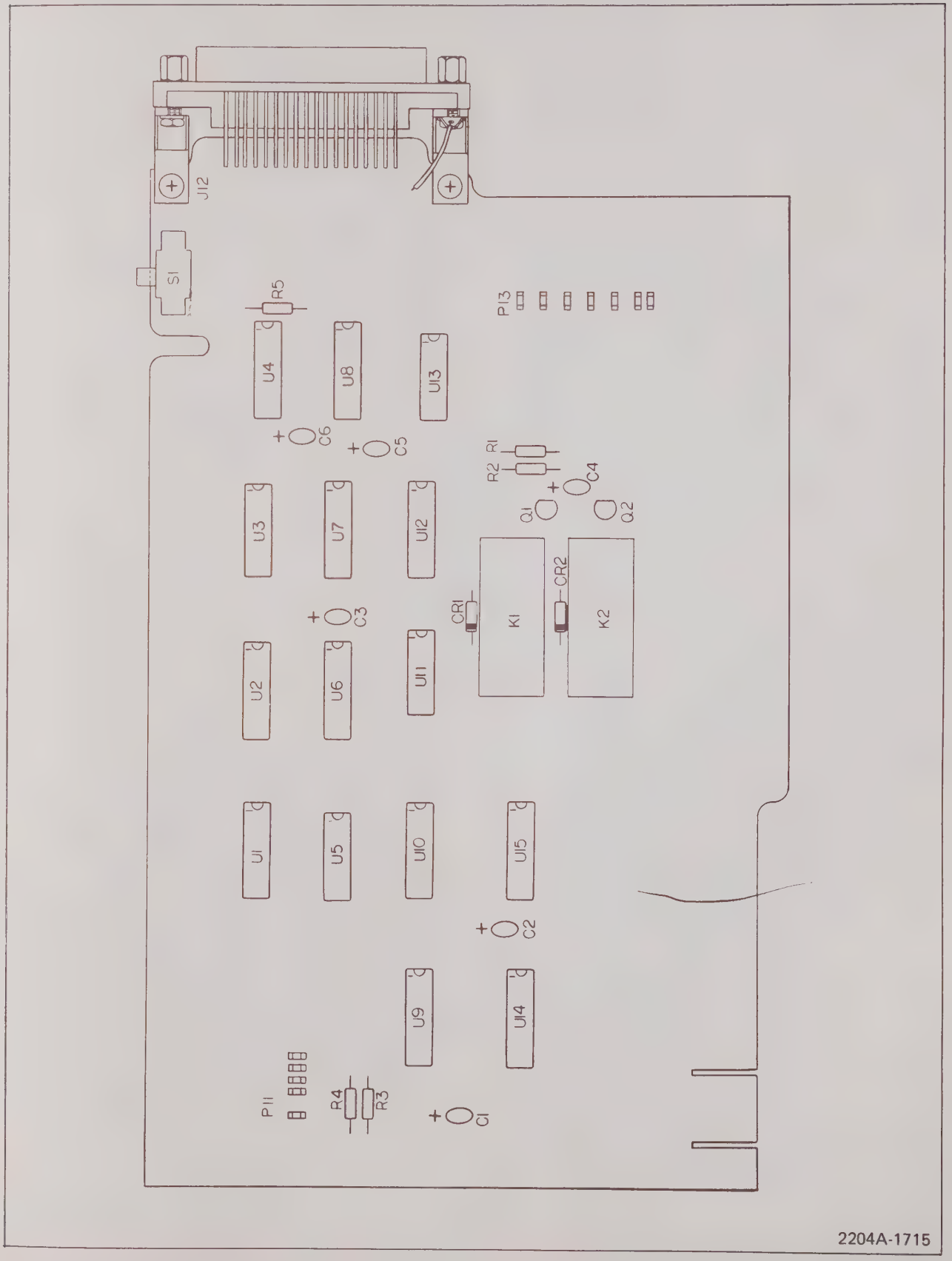
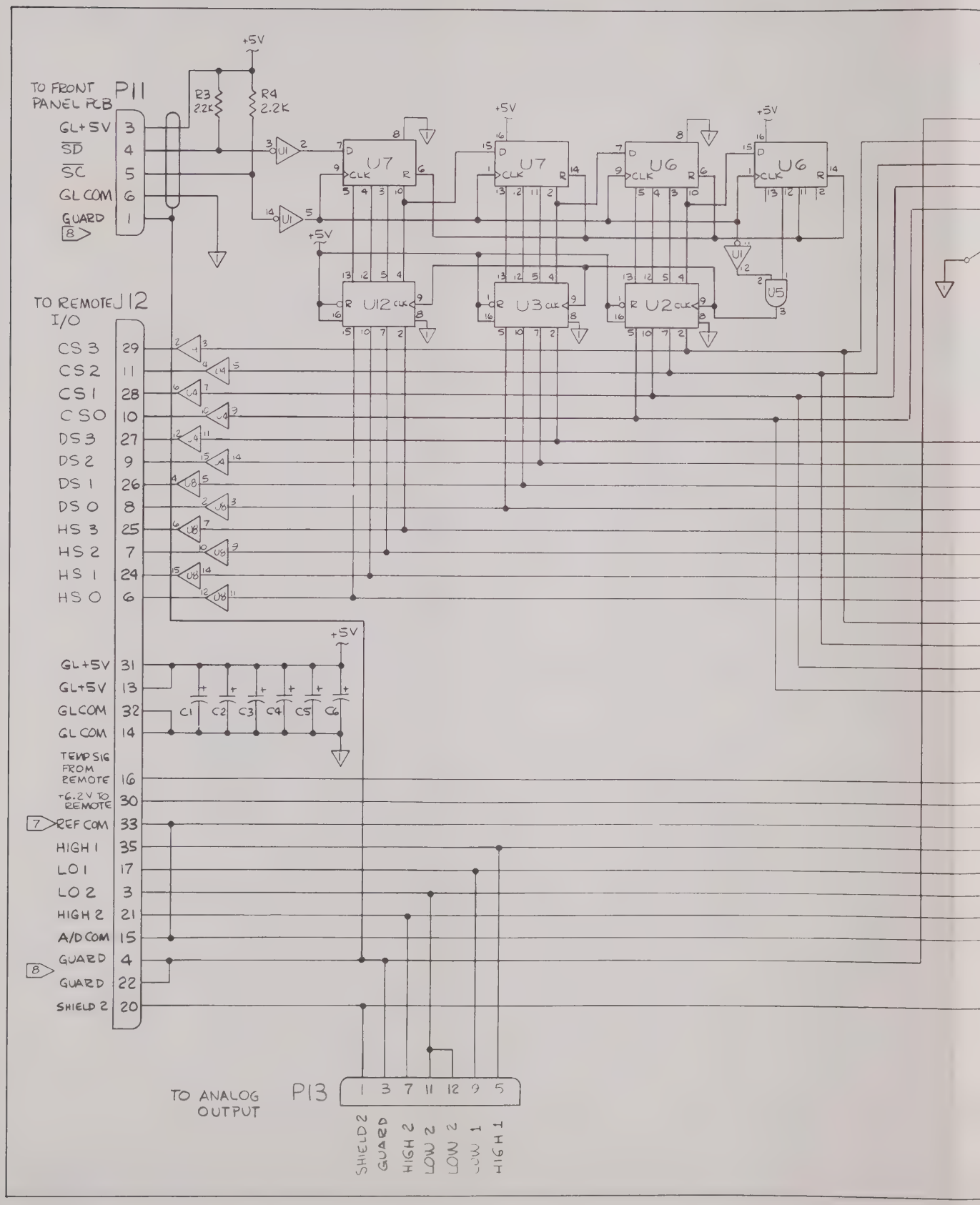
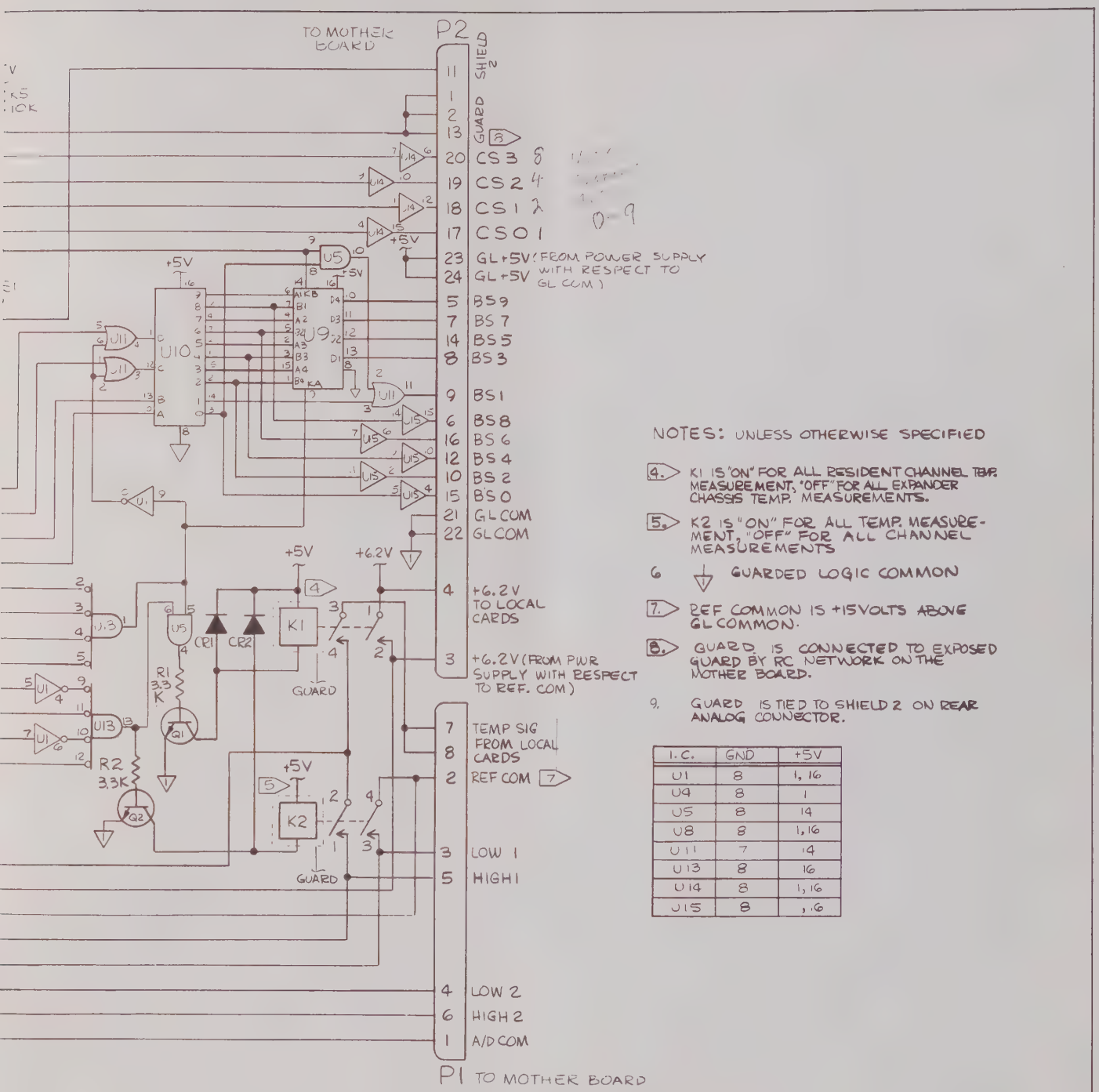


Figure 8-5. A2A2 Extended Bus PCB Assembly


TO FRONT PANEL PCB
P11
GL+5V 3
SD 4
SC 5
GL COM 6
GUARD 1
8
+5V
R3 22K
R4 2.2K
U1
U7
U6
U12
U3
U2
U5
TO REMOTE I/O
J12
CS 3 29
CS 2 11
CS 1 28
CS 0 10
DS 3 27
DS 2 9
DS 1 26
DS 0 8
HS 3 25
HS 2 7
HS 1 24
HS 0 6
GL+5V 31
GL+5V 13
GL COM 32
GL COM 14
C1
C2
C3
C4
C5
C6
TEMP SIG FROM REMOTE 16
+6.2V TO REMOTE 30
7
REF COM 33
HIGH 1 35
LO 1 17
LO 2 3
HIGH 2 21
A/D COM 15
GUARD 4
8
GUARD 22
SHIELD 2 20
TO ANALOG OUTPUT
P13
1 3 7 11 12 9 5
SHIELD 2
GUARD
HIGH 2
LOW 2
LOW 1
HIGH 1



NOTES: UNLESS OTHERWISE SPECIFIED

4. K1 IS "ON" FOR ALL RESIDENT CHANNEL TEMP. MEASUREMENT, "OFF" FOR ALL EXPANDER CHASSIS TEMP. MEASUREMENTS.

5. K2 IS "ON" FOR ALL TEMP. MEASUREMENT, "OFF" FOR ALL CHANNEL MEASUREMENTS

6 ⏚ GUARDED LOGIC COMMON

7. REF COMMON IS +15VOLTS ABOVE GL COMMON.

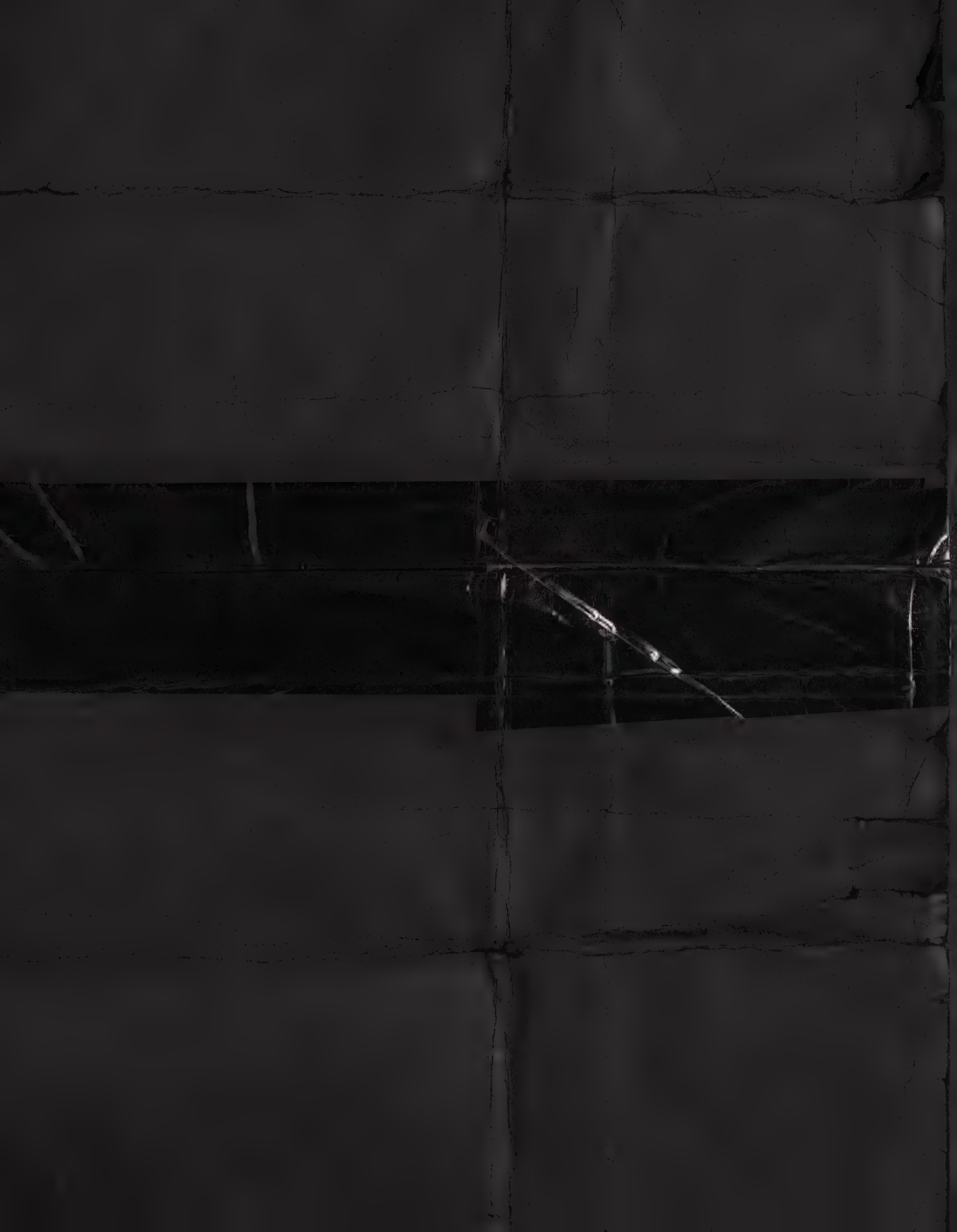
8. GUARD IS CONNECTED TO EXPOSED GUARD BY RC NETWORK ON THE MOTHER BOARD.

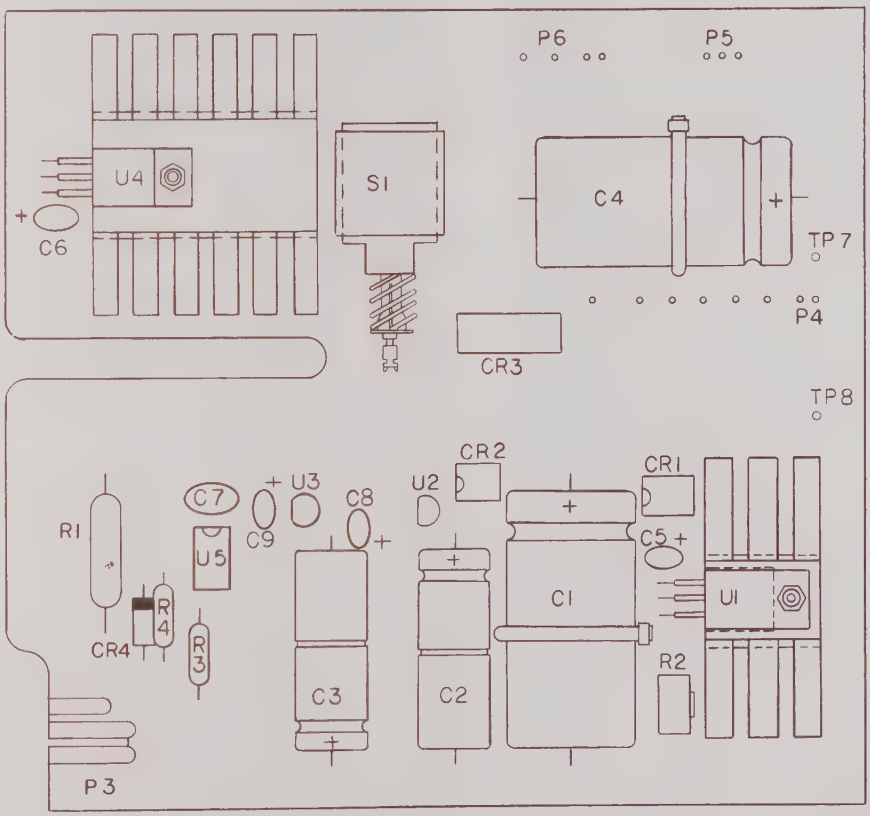
9. GUARD IS TIED TO SHIELD 2 ON REAR ANALOG CONNECTOR.

I.C.	GND	+5V
U1	8	1, 16
U4	8	1
U5	8	14
U8	8	1, 16
U11	7	14
U13	8	16
U14	8	1, 16
U15	8	1, 16

2204A-1015

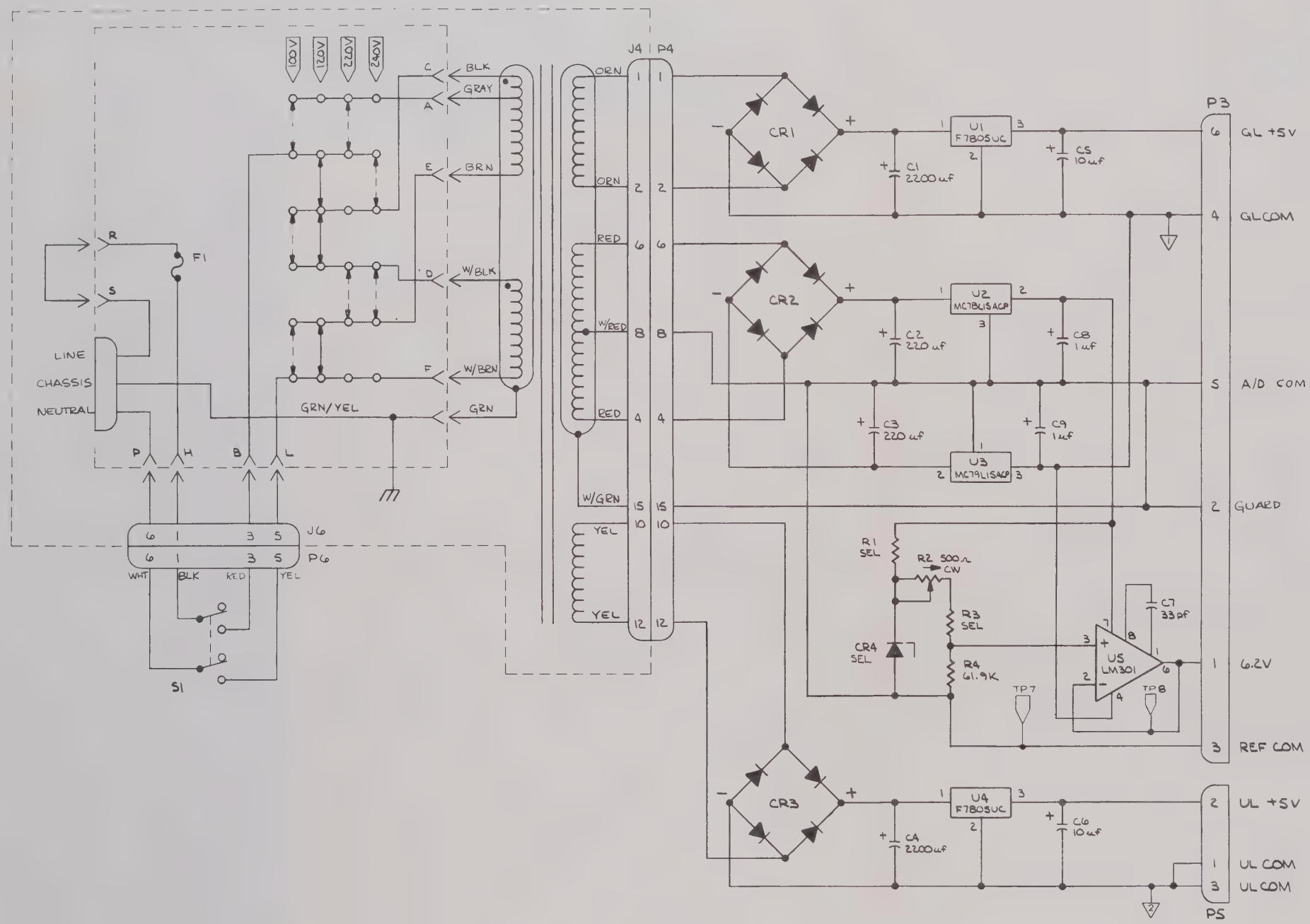
Figure 8-5. A2A2 Extended Bus PCB Assembly (cont)





2204A-1705

Figure 8-6. A2A3 Power Supply PCB Assembly

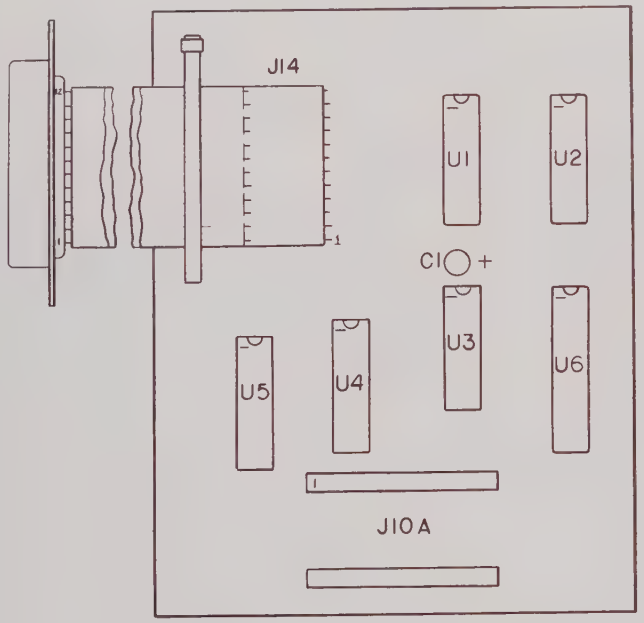


NOTES: UNLESS OTHERWISE SPECIFIED

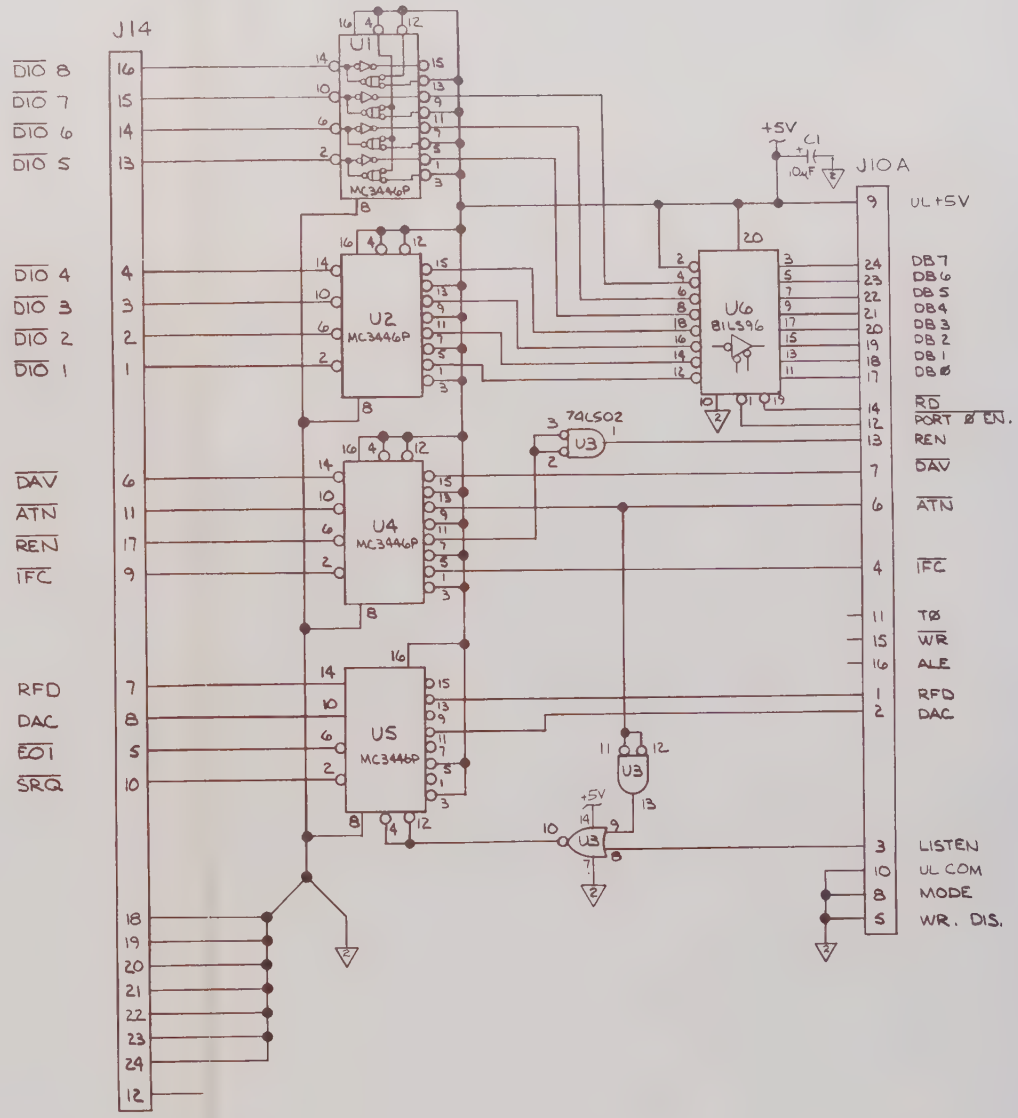
4. LAST REF. DES. NO.'S USED U5, CR4, R4, C9.
5. INFORMATION CONTAIN WITHIN DASH LINES IS FOR REFERENCE ONLY
6. ⏚ = GUARDED LOGIC COMMON
7. ⏚ = UNGUARDED LOGIC COMMON.

2204A-1005

Figure 8-6. A2A3 Power Supply PCB Assembly (cont)



2204A-1712



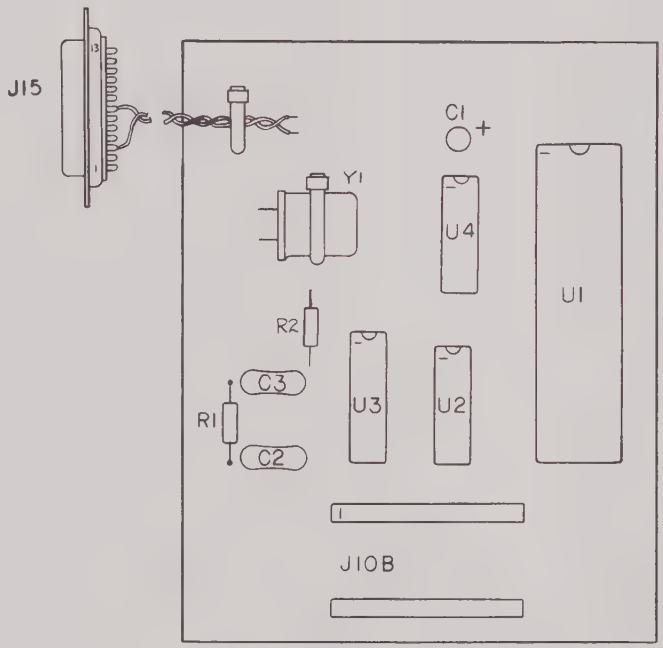
I/O CONNECTOR

NOTES: UNLESS OTHERWISE SPECIFIED

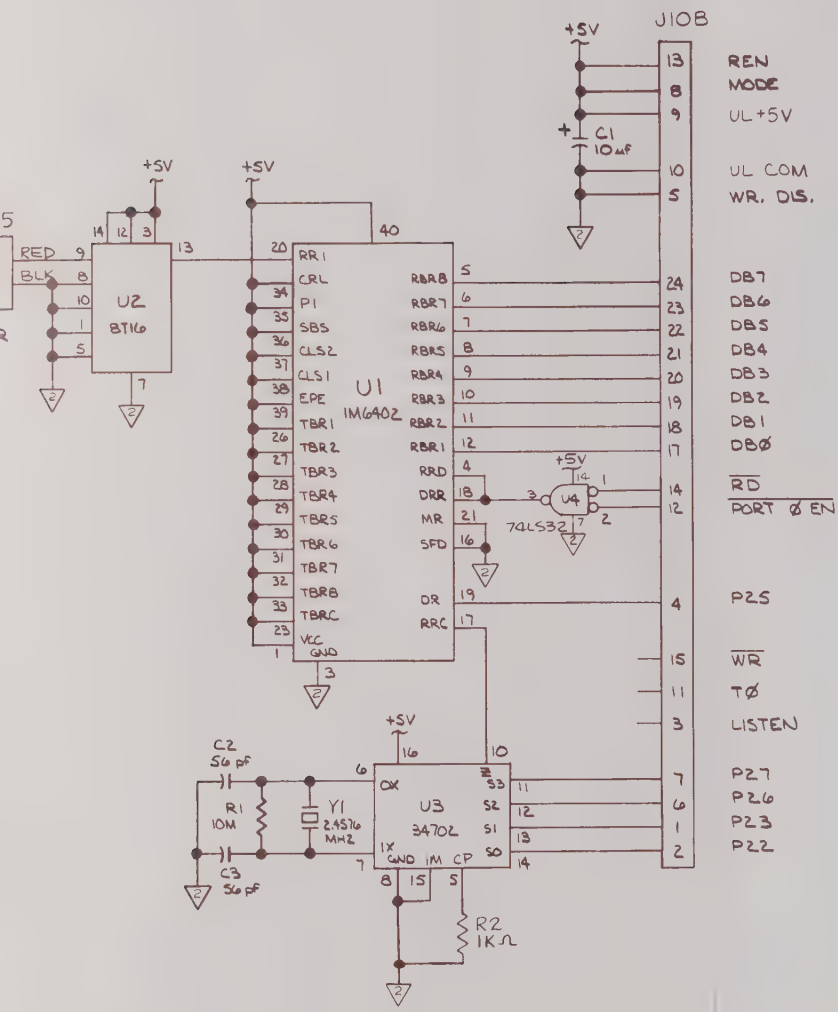
4. LAST REF. DES. NO.'S USED; U6, J2
5. ▽ = UNGUARDED LOGIC COMMON
6. CORRESPONDING IEEE-488 PCB IS CONFIGURED AS -050 OPTION FOR THE 2204A.

2204A-1012

Figure 8-7. Option -050, IEEE-488 Interface PCB Assembly



I/O CONNECTO

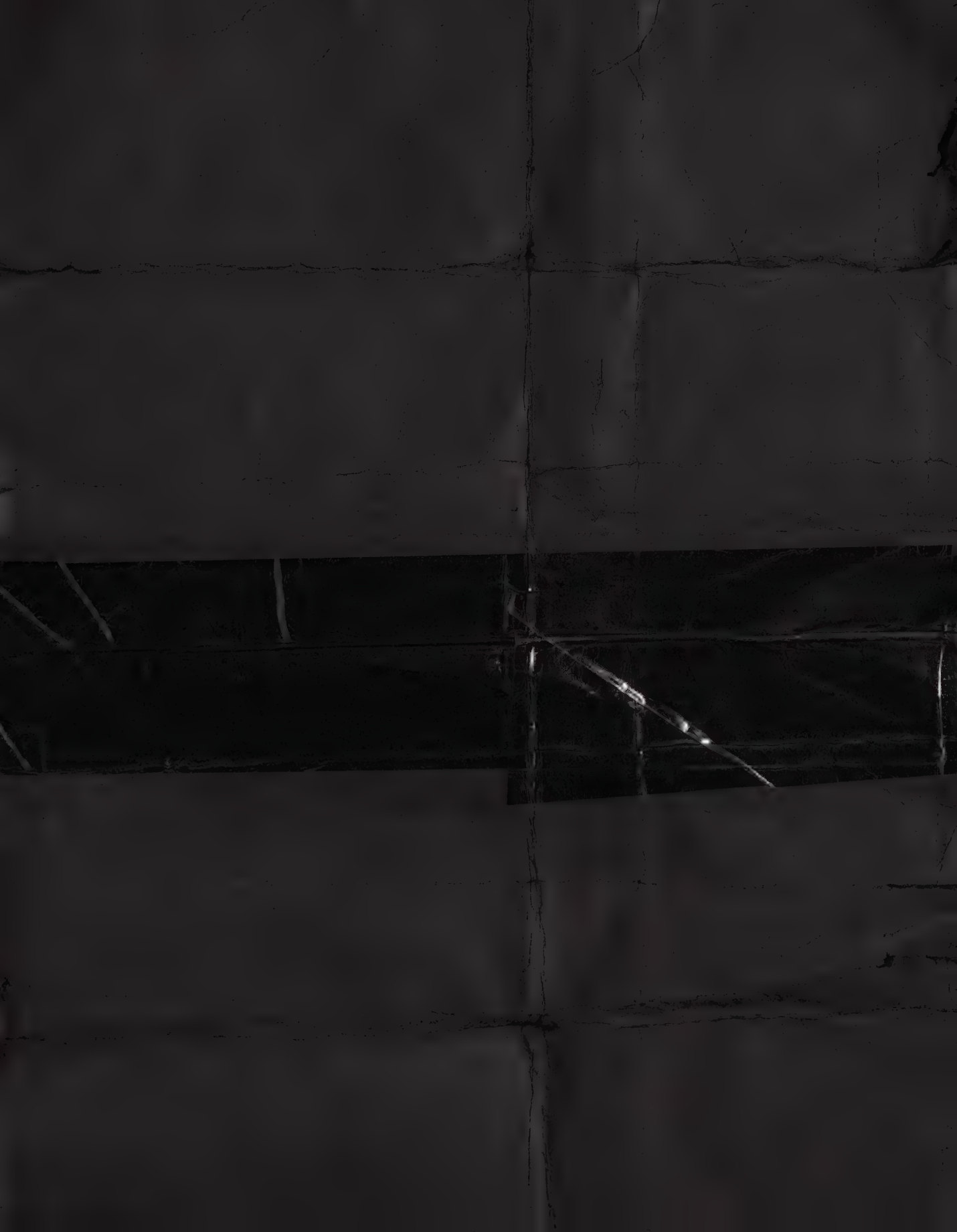


NOTES: UNLESS OTHERWISE SPECIFIED

4. LAST REF. DES. NO.'S USED: U4, R1, C3, Y1.
5. ▽ = UNGUARDED LOGIC COMMON

2204A-1011

Figure 8-8. Option -060, RS-232-C Interface PCB Assembly



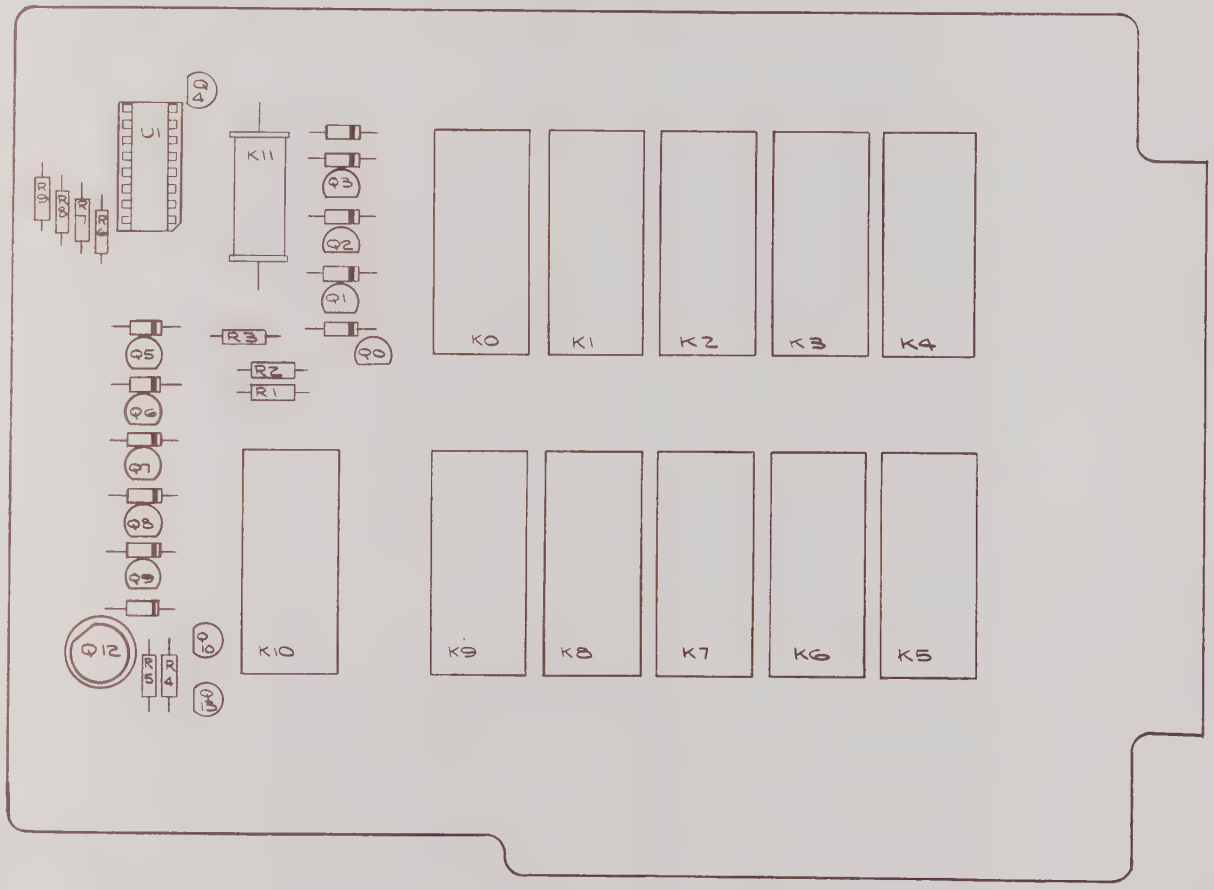
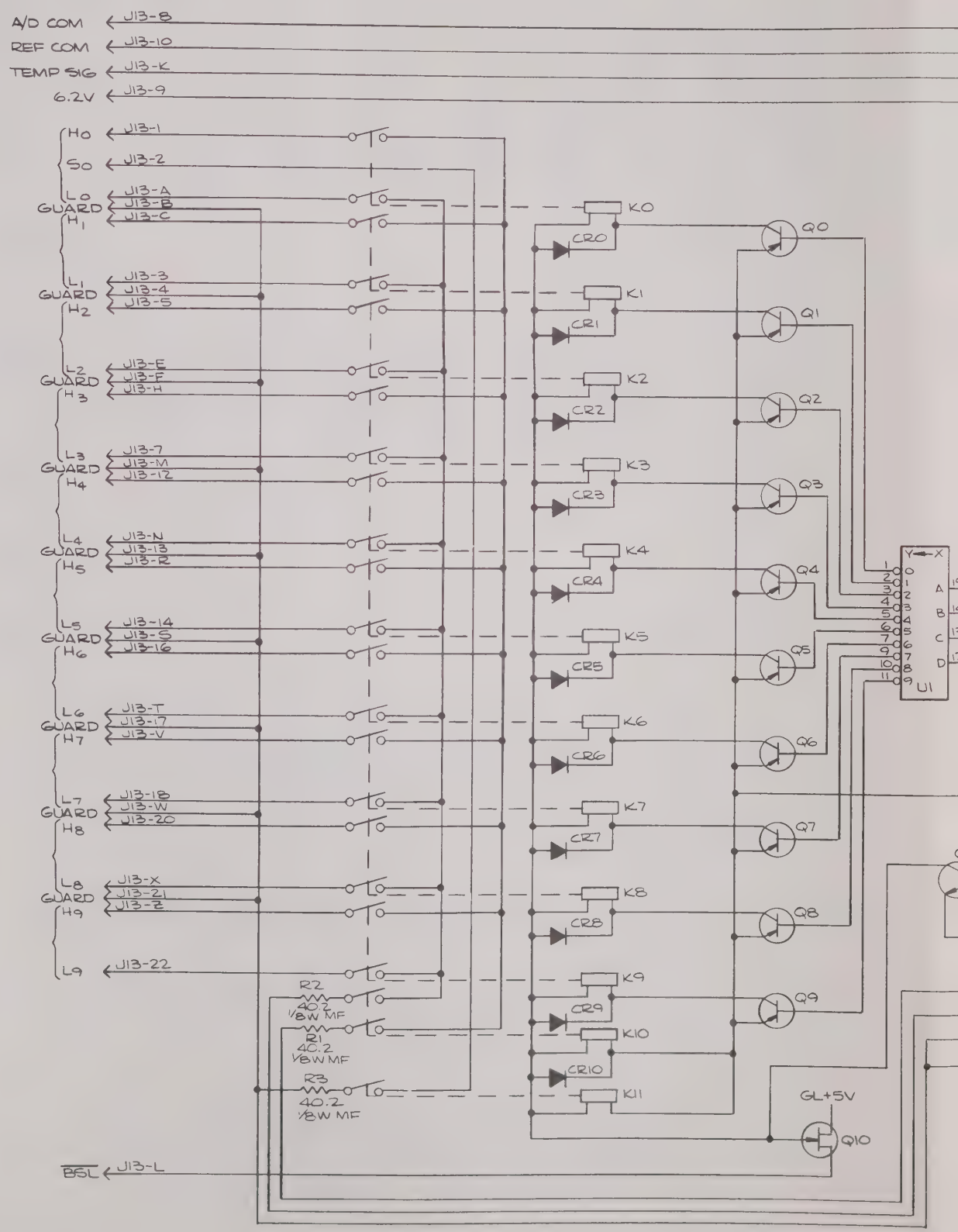
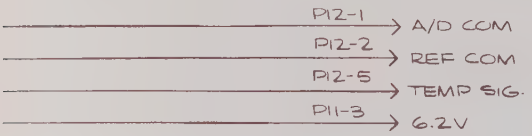


Figure 8-9. Option -310, General Purpose Scanner PCB Assembly

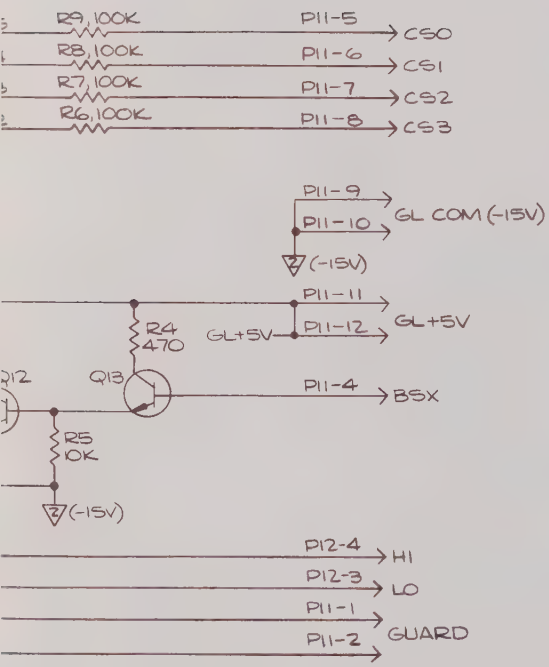

A/D COM
REF COM
TEMP SIG
6.2V
J13-8
J13-10
J13-K
J13-9
H0
S0
L0
GUARD
H1
L1
GUARD
H2
L2
GUARD
H3
L3
GUARD
H4
L4
GUARD
H5
L5
GUARD
H6
L6
GUARD
H7
L7
GUARD
H8
L8
GUARD
H9
L9
J13-1
J13-2
J13-A
J13-B
J13-C
J13-3
J13-4
J13-5
J13-E
J13-F
J13-H
J13-7
J13-M
J13-12
J13-N
J13-13
J13-R
J13-14
J13-S
J13-16
J13-T
J13-17
J13-V
J13-18
J13-W
J13-20
J13-X
J13-21
J13-Z
J13-22
K0
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
K11
CR0
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
R2
40.2
1/8W MF
R1
40.2
1/8W MF
R3
40.2
1/8W MF
GL+5V
U1
Y
X
A
B
C
D
BSL
J13-L



NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ▽ (-15V) DENOTES GUARDED LOGIC COMMON [GL COM (-15V)] WHICH IS -15V WITH RESPECT TO A/D COM.
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.

6 ALL VOLTAGES NOTED ARE WITH RESPECT TO A/D COM.



I.C. REF DES	PIN NO. GL+5V	PIN NO. GL COM
U1	16	8

REFERENCE DESIGNATIONS LAST USED		NOT USED	
CR10 K1 Q13 R9	U1	Q11	

2200A-1037

Figure 8-9. Option -310, General Purpose Scanner PCB Assembly (cont)

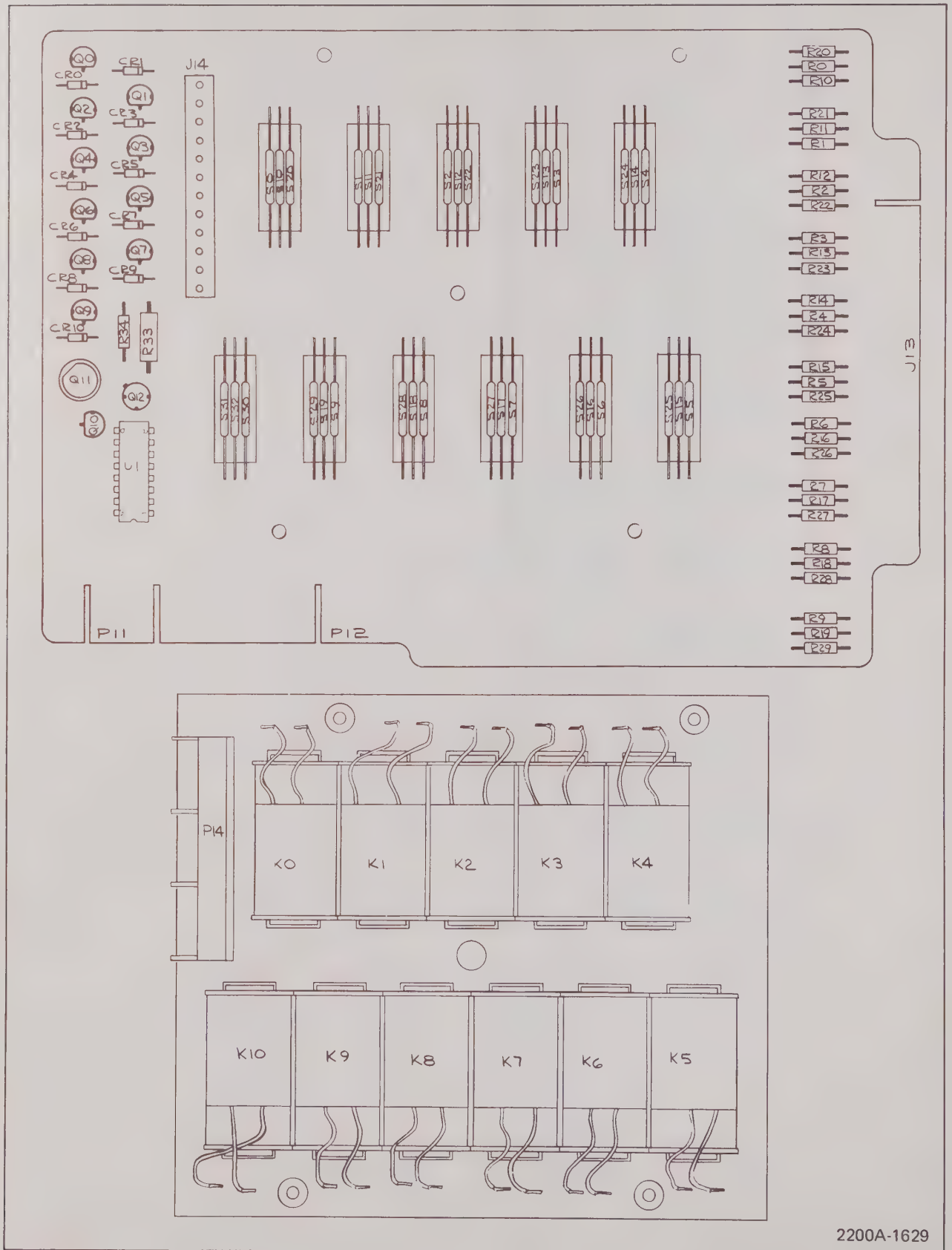
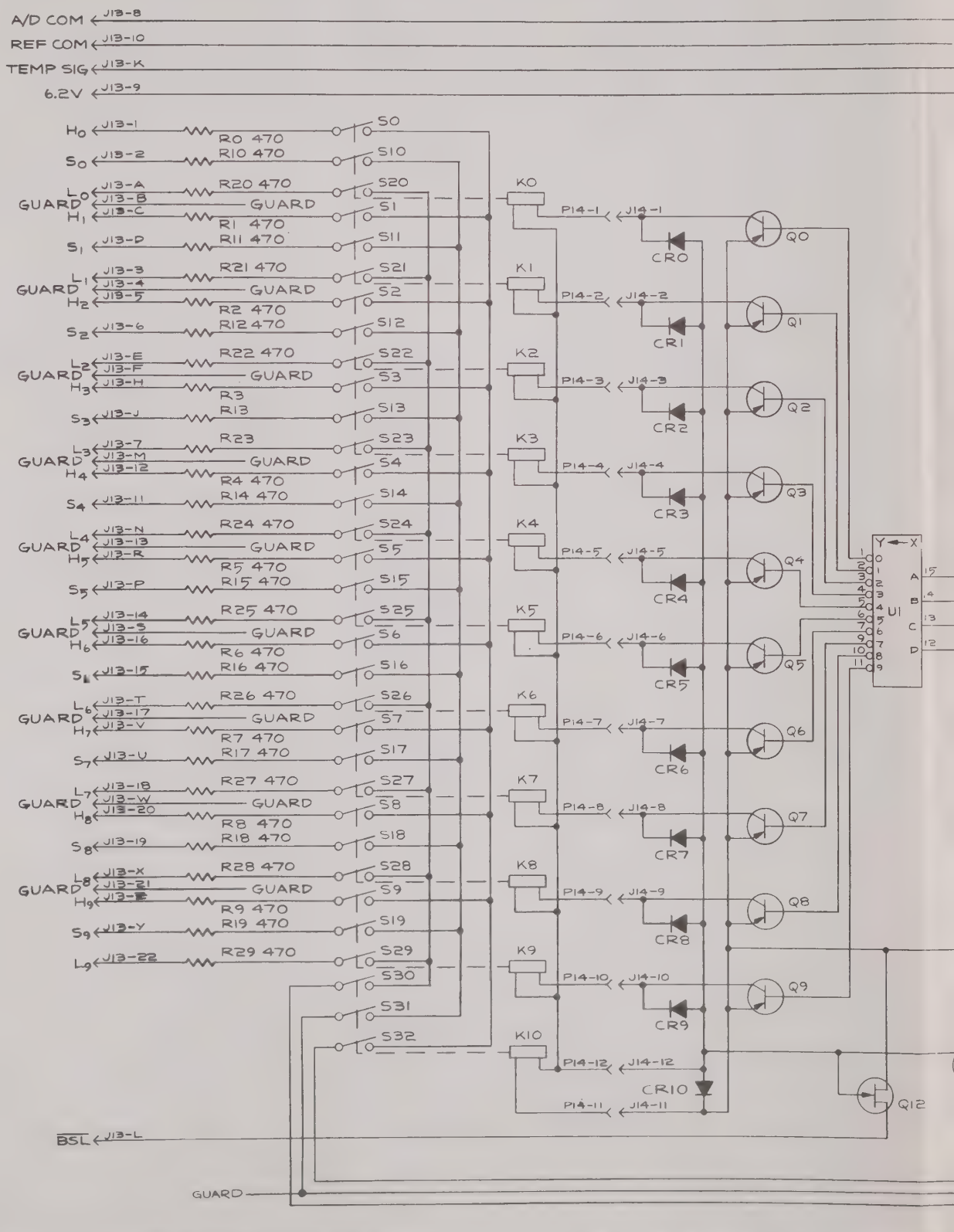
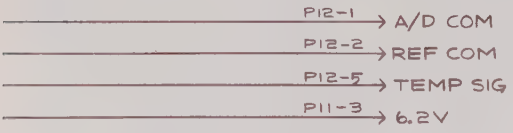


Figure 8-10. Option -06, Low Level Scanner PCB Assembly


A/D COM J13-8
REF COM J13-10
TEMP SIG J13-K
6.2V J13-9
H0 J13-1
R0 470
S0
S10
S0 J13-2
R10 470
L0 J13-A
J13-B
J13-C
GUARD
R20 470
S20
S1
H1
R1 470
S11
S1 J13-D
R11 470
L1 J13-3
J13-4
J13-5
GUARD
R21 470
S21
S2
H2
R2 470
S12
S2 J13-6
R12 470
L2 J13-E
J13-F
J13-H
GUARD
R22 470
S22
S3
H3
R3
S13
S3 J13-J
R13
L3 J13-7
J13-M
J13-12
GUARD
R23
S23
S4
H4
R4 470
S14
S4 J13-11
R14 470
L4 J13-N
J13-13
J13-R
GUARD
R24 470
S24
S5
H5
R5 470
S15
S5 J13-P
R15 470
L5 J13-14
J13-3
J13-16
GUARD
R25 470
S25
S6
H6
R6 470
S16
S6 J13-15
R16 470
L6 J13-T
J13-17
J13-V
GUARD
R26 470
S26
S7
H7
R7 470
S17
S7 J13-U
R17 470
L7 J13-18
J13-W
J13-20
GUARD
R27 470
S27
S8
H8
R8 470
S18
S8 J13-19
R18 470
L8 J13-X
J13-21
GUARD
R28 470
S28
S9
H9
R9 470
S19
S9 J13-Y
R19 470
L9 J13-22
R29 470
S29
S30
S31
S32
K0
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
P14-1
P14-2
P14-3
P14-4
P14-5
P14-6
P14-7
P14-8
P14-9
P14-10
P14-12
P14-11
J14-1
J14-2
J14-3
J14-4
J14-5
J14-6
J14-7
J14-8
J14-9
J14-10
J14-12
J14-11
CR0
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q12
U1
Y
X
A
B
C
D
BSL J13-L
GUARD

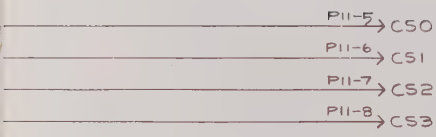


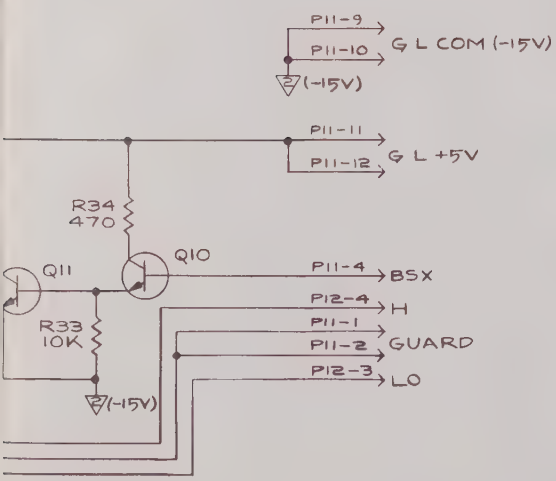
NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ⬡ DENOTES CALIBRATION ADJ POINTS. ALL POINTS ARE SCREWDRIVER ADJUST.
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.2. AND Y32.14.
5. ▽(-15V) DENOTES GUARDED LOGIC COMMON [GL COM (-15V)] WHICH IS -15V WITH RESPECT TO A/D COM.
7. ALL VOLTAGES NOTED ARE WITH RESPECT TO A/D COM.

I.C. REF. DES.	PIN NO.	
	GL +5V	GL COM
U1	16	8

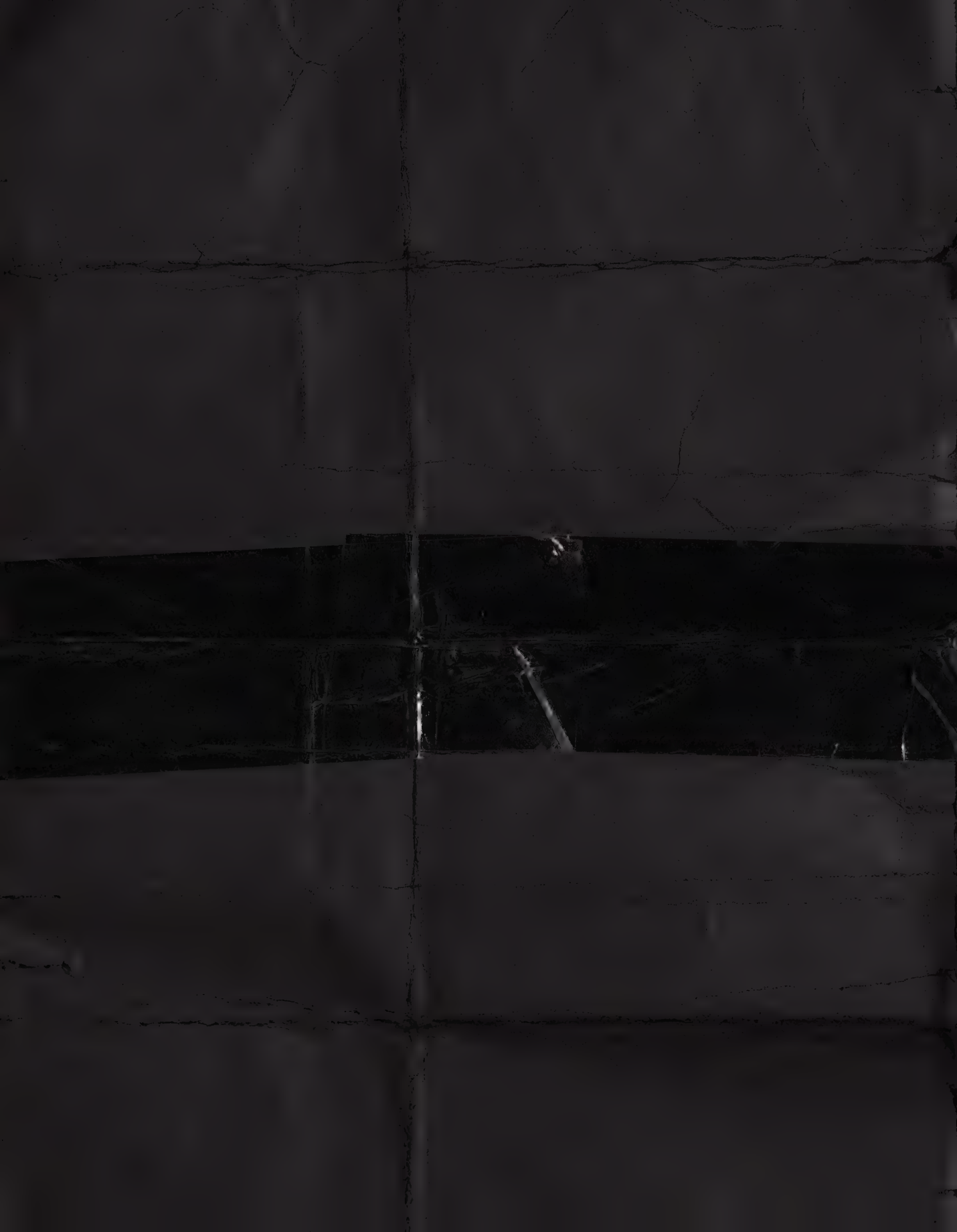
REFERENCE DESIGNATIONS			
LAST USED		NOT USED	
CR10 K10 Q12 R34	532 U1	R30-32	

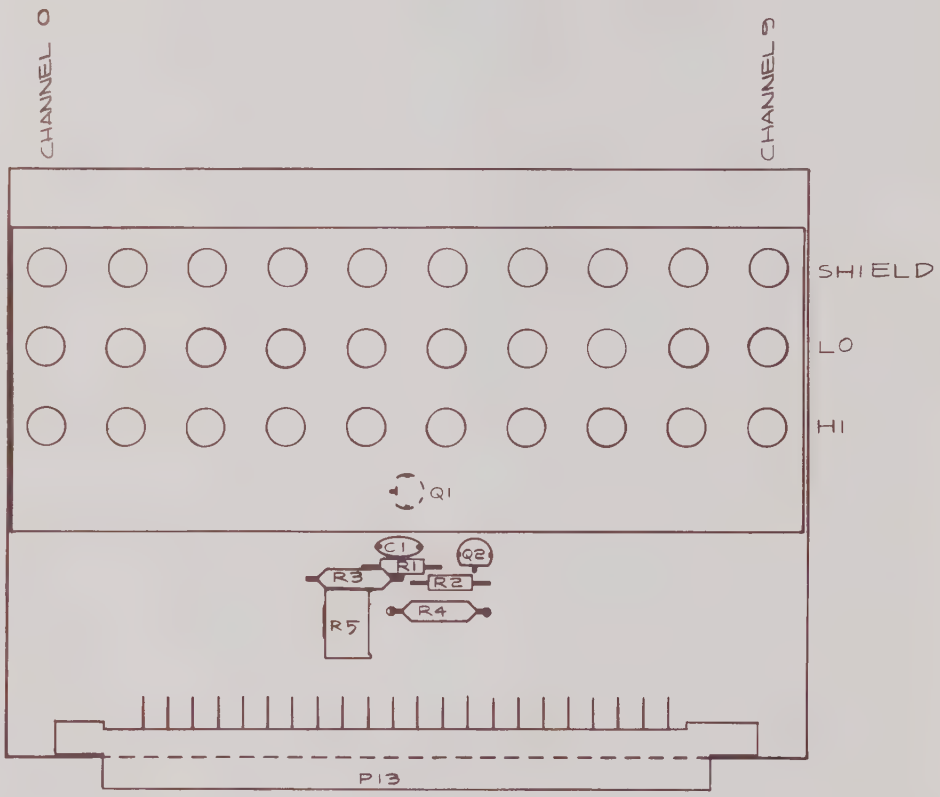




2200A-1029

Figure 8-10. Option -06, Low Level Scanner PCB Assembly (cont)





2200A-1623

Figure 8-11. Option -08, Isothermal Block Connector

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ⬡ DENOTES CALIBRATION ADJ POINTS. ALL POINTS ARE SCREWDRIVER ADJUST.
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.2.

6 R4 IS FACTORY SELECTED AND IS ONE OF THE LISTED VALUES:

OPEN	100K
287K	76.8K
147K	

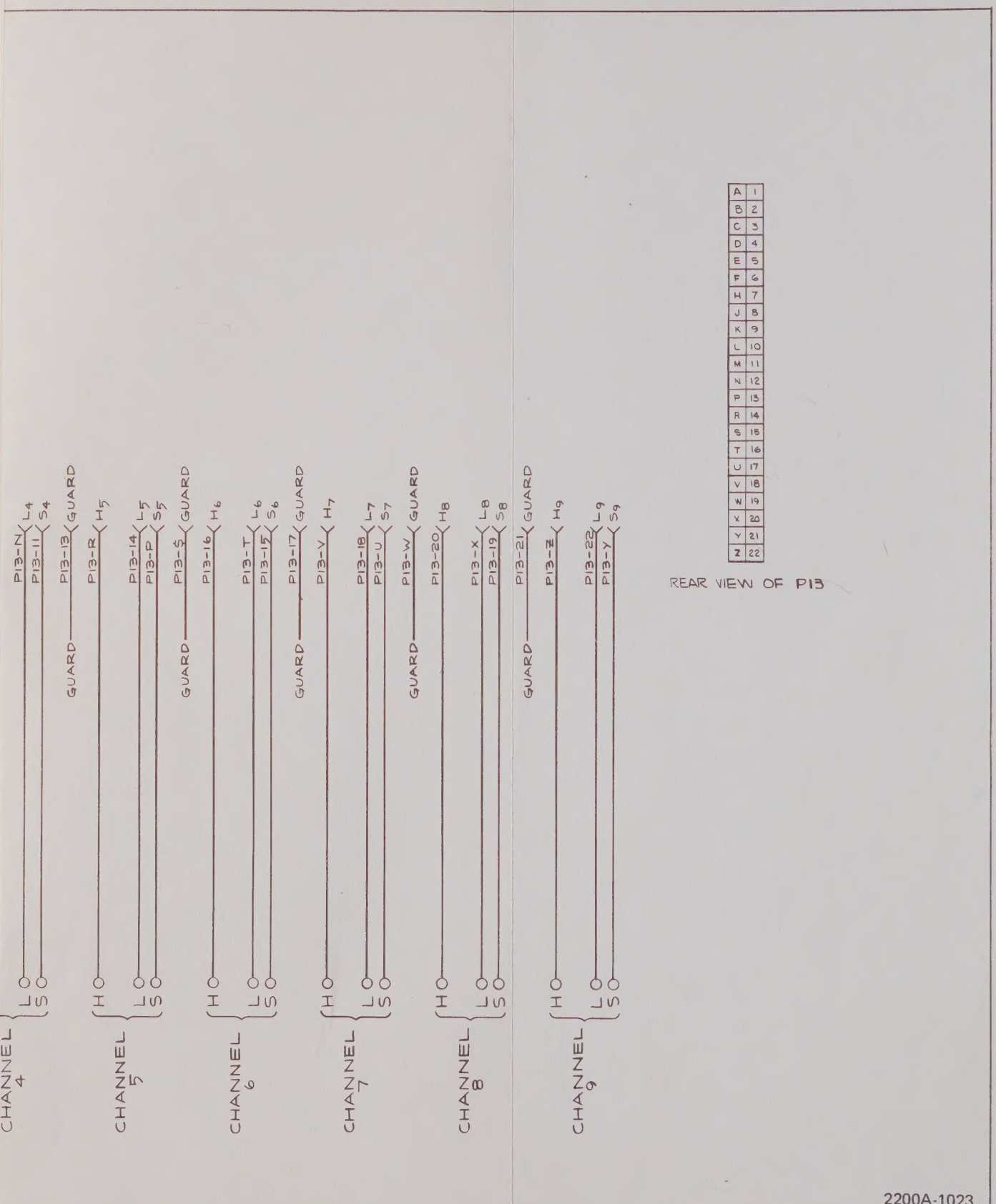


Figure 8-11. Option -08, Isothermal Block Connector (cont)

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